

# The importance of credit and capital in the Norwegian banking system during crisis-

A comparative study of the Norwegian banking  
crisis and the recent financial crisis

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” For the second time in seven years, the bursting of a major-asset bubble has inflicted great damage on world financial markets. In both cases, the equity bubble in 2000 and the credit bubble in 2007, central banks were asleep at the switch. The lack of monetary discipline has become a hallmark of unfettered globalization. Central banks have failed to provide a stable underpinning to world financial markets and to an increasingly asset-dependent global economy.” - *Stephen Roach, Morgan Stanley*

“A bank is a place where they lend you an umbrella in fair weather and ask for it back when it begins to rain.” – *Robert Frost*

## Preface

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The research for this thesis was done over the course of 2010 and it was written between August and December of that same year. The decision to write about the two most recent crises in the Norwegian banking industry was first and foremost inspired by a strong personal interest in the recent financial crisis. I find the economic organization of banks and how their operation affects the rest of the economy fascinating. In addition to five years of economic studies, much of the relevant technical background came from the course ECON 4335 The Economics of Banking. I would therefore like to thank Jon Vislie, Bent Vale and Asbjørn Rødseth for providing me with the necessary tools in advance to deal with the sometimes complex workings of the banking industry.

For providing corrections and for pointing me in the right direction prior to and during the writing process, I would also like to thank my supervisor Tore Nilssen. I appreciated his product oriented view of the master's thesis. He also pushed the process forward by setting sometimes ambitious deadlines, supplying me with relevant reading material, and helping me to get in touch with Norges Bank.

I would like to thank Bjørn Bakke and Bjørne Dyre Syversten from Norges Bank for reading a draft and agreeing to see me halfway through the writing process. We had a very constructive meeting and they provided me with a wide array of material to improve upon the empirical parts of my thesis.

I would like to thank Ida Karlsson and Morten Schøning as non-economists for reading my final draft and giving feedback about spelling mistakes as well as where I fail to make common sense.

Finally, I would like to give a special thank you (and a bit of an apology) to my friends and family for showing patience and keeping me sane during my growing social isolation this semester.

## Summary

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My thesis investigates the two most recent crises affecting the Norwegian banking system, namely the Norwegian banking crisis from 1988 to 1993 and the recent financial crisis reaching Norwegian markets in 2008. Although the financial crisis was a global phenomenon and originated from the US mortgage market, my main focus will be on the Norwegian system and how it was affected by the spillovers from international markets. Chapters 2 and 3 provide a presentation of the two crises and chapter 4 compares them in some key respects.

Even though every banking crisis has some unique characteristics, there also exist several fundamental similarities. Banks, through their organization, are exposed to external shocks affecting market risks, the capitalization of firms and consumers, and aggregate investment. The main task of a commercial bank is to act as a financial intermediary, transforming deposits from customers and funding by outside investors into loans and further investments. Profits are generated from earning a higher interest or return on the loans and investments than what is demanded by depositors and investors. An unregulated, profit maximizing bank will try to expand its activity as much as possible in proportion to its own capital.

Loans are often long-term and considered less liquid than deposits. This maturity-mismatch between investments and funding is an important source of risk to a bank since the premature liquidation of assets is likely to drive down their prices. Falling asset prices can cause a bank to become illiquid and eventually insolvent. Being liquid means that the bank at all times possesses legal tender to service transactions, like withdrawals, while solvency means that the value of the bank's assets exceeds the value of the bank's liabilities excluding own capital. When a bank is suffering from decreasing asset values due to for example an increasing number of defaults on its loans, solvency is upheld by the share of a bank's capital that can be written down as compensation, for example stocks, but obviously not deposits.

Prior to both crises, banks kept only small levels of capital relative to their operations. Investments were largely funded by relatively cheap short-term debt which can be difficult to refinance in a recession. While such a strategy is capable of boosting earnings during periods of strong economic growth, it will also increase risk exposure and thus likely contribute to larger financial problems during a recession. In other words, a short-term profit maximizing strategy will increase the impact of fluctuations in the business-cycle on the banking system and the real economy, and can be referred to as pro-cyclical banking.

Chapter 5 I introduces a model by Holmström and Tirole from 1997 which shows how moral hazard creates a need for intermediaries in the financial system. Banks can monitor investments through repeated transactions with their borrowers and can make the arrangement efficient by exploiting economies of scale. The monitoring alleviates the moral hazard problem. Individual investors are assumed to find monitoring to be too expensive to undertake themselves. Banks can therefore profit on financing a market share of firms considered too risky or opaque by individual, uninformed investors. Within this framework, the authors illustrate how the volume of credit and capital in the system affect investment, financial intermediaries and regular firms. Since the model was designed in the time period between the two crises in question and was partly inspired by the Norwegian banking crisis, I will test its explanatory powers on recent events.

My thesis will, in the light of the two banking crises, examine how pro-cyclical banking affects the availability of credit in the market and how this in turn affects firms dependent on debt financing from banks. I will also look at how the business cycle affects banks' lending behavior and their approach to risk. By looking at the two most recent crises to the Norwegian banking system, I will point to similarities and differences. Unregulated banks are under pressure to offer its investors and shareholders with a competitive rate of return. If the whole system gravitates towards maximizing short-term profits at potentially high future risk of default, then the banking system is in a bad equilibrium in the sense that longevity and a stable credit supply is undermined.

There has been clear progress in the way Norwegian banks operate since the Norwegian banking crisis. Improved regulation and higher capital levels have rendered the banking system more robust against external shocks. Still government intervention to restore system liquidity was required during the recent crisis. Internationally, there has also been an increased use of financial innovation, with the effect of banks moving risky assets off their balance sheets, enabling them become highly leveraged despite regulation. I therefore feel that a thesis questioning certain fundamental, possibly destabilizing aspects of banking is very relevant in light of the recent financial crisis.



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## 1 Introduction

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The world economy is recovering from a financial crisis which most notably left the United States in the deepest recession since World War II. At the center of events were the failures of large banks like Lehman Brothers and Bear Stearns, the run on the UK bank Northern Rock, and the controversy concerning government rescue packages. The IMF has been monitoring the aggregate losses suffered by banks and other financial institutions due to the financial crisis. As of April 2009 the reduced value of total holdings had reached a staggering \$4 trillion. Of that amount, \$2.7 trillion were from loans and assets originating from the US alone (IMF, 2009). World leaders at the G-20 meeting, which took place in London the same year, suggested injecting \$1.1 trillion into the world's financial markets to rectify the situation (ibid). Even though Norway has fared relatively well compared to other European economies, the crisis made apparent several weaknesses in the banking system also relevant for Norwegian banks.

A series of regulatory efforts to strengthen the banking industry against adverse shocks have been put forth by the Basel Committee and the EU over the last two decades. Although every economic crisis has different traits and origins, there are also several common denominators when looking at a more basic level. Banks, through their economic organization, are vulnerable to fluctuations in business-cycles. As major suppliers of credit to consumers and firms, the failure of banks affects both their depositors and their lenders in addition to shareholders and employees. A systemic banking crisis can thus have widespread negative effects on the real economy, as the resulting credit crunch prevents clients from getting loans. For an explanation of what is meant by a systemic banking crisis, as well as other concepts relating to the economics of banking like credit, capital requirements, liquidity, leverage, etc. see appendix 1. The existing regulatory system is currently being criticized for proving ineffective in dampening the recent boom-bust cycle in credit availability, leverage and housing prices (Brunnermeier et al, 2009). Regulators failed to tighten regulations on capital and liquidity during the period of economic growth prior to the crisis, and the efforts made by banks and other financial institutions to maximize short-term profits were in effect, largely unaffected by the prevailing regulatory system. It also took a long time before a relaxation of regulations came about during the subsequent recession to prevent their pro-cyclical effect (ibid).

This thesis will focus on the importance of banks' lending behavior and credit access prior to and during the two most recent crises in the Norwegian banking system. I will look at how inherent incentives and weaknesses in the banking system, where left unregulated, can be

a source of economic instability, and how the deterioration of bank capital and aggressive investment strategies and overextension during booms increase the chances of a subsequent crisis as the economy slows down. I will further argue that similar unfortunate circumstances may occur again in the absence of some important structural changes.

Chapters 2 and 3 will go through the details of Norwegian Banking crisis 1988-1993 and the recent financial crisis respectively. The focus will be on how banks have approached credit risk and capital requirements and how incentives in the credit market have affected their behavior prior to both crises. While my main concern is the Norwegian banking system, chapter 3 will also feature facts about subprime lending and some important international changes in banking. With the findings in this first part of my thesis as a basis, I will use chapter 4 to ask some key questions about the banking system to be analyzed and answered during the second part.

The model by Holmström and Tirole (1997) to be presented in detail in chapter 5 will be the point of departure for further analysis. The model categorizes Banks as financial intermediaries and proceeds to explain the relationship between these financial intermediaries, uninformed investors, and firms in the credit market of a stylized economy. The authors use contract theory to illustrate how aggregate investment is affected by a credit crunch and a capital squeeze, phenomena that typically occur during a recession or a financial crisis. In fact, the model's general predictions about the credit market fit the Norwegian banking crisis well and my thesis will test its explanatory powers on the experiences of the recent financial crisis, focusing on the systemic effects arising in the credit market as the economy goes from boom to bust.

Chapter 6 will supplement the discussion with some relevant insights from other theories and will point to important aspects of the two banking crises not covered by model of the previous chapter. The thesis will present a limited, yet consistent body of economic theory and empirical examples to understand the workings of the market for bank loans prior to and during an economic slowdown, and use it to suggest some measures that can render the banking system more robust to adverse shocks. Changes are not implementable without a cost, but the recent economic turmoil and relevant developments within international financial regulation, will hopefully validate the claim that these changes are ultimately beneficial for the economy. Chapter 7 presents some insights into the evolution of bank regulation and concludes.

## **2 The Norwegian banking crisis 1988-1993**

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In the 1980s, financial deregulation induced Norwegian banks to increase their lending activity and to compete for market shares by adopting an expansionist strategy. The result was in an aggregate expansion of credit. The following recollection of the Norwegian banking crisis will largely draw on the articles by Vale (2004), Steigum (2004) and Moe (2004).

### **2.1 Quantitative loan restrictions and credit rationing**

Norwegian banks faced very little credit risk before the financial deregulation took place, due to the up until then, forced rationing of credit imposed by the government. As explained in Steigum (2004), a heavy national regulation of the banking sector had been in place since the end of World War II, and was having profound effects on how banks operated.

Credit rationing implies that the demand for credit exceeds supply and can occur naturally in the market for bank loans even in the absence of regulation. Because of asymmetric information and adverse selection it may be optimal for a bank to deny some high risk applicants financing. However, it is worth mentioning that a pure credit rationing equilibrium comes with the additional requirement that, if two identical agents apply for a loan, then one might be rejected simply because credit is scarce (Stiglitz and Weiss, 1981).

The government forced rationing of credit in Norway gave individual banks the incentive to thoroughly screen loan applicants, and they were thus being able to construct very safe asset portfolios with low delinquency rates. Vale (2004) notes that there was a continuous queue of unsatisfied credit demand, allowing banks to pick the best customers. Needless to say, the risks involved in commercial banking were very modest during this period. When the market was finally deregulated, the Norwegian banks had very little experience operating in a much more competitive environment. The credit expansion following deregulation predictably resulted in increased credit risk.

### **2.2 Financial deregulation, credit expansion and price bubbles**

Deregulation became inevitable as Norwegian businesses gradually gained easier access to international financial markets and in 1984 the quantitative regulation on bank lending was lifted. Shortly after, in 1985 a cap on the maximum legal interest rate to be charged on bank loans was also removed. The result of these measures was a lending boom. The annual real growth in bank loans was above 20 percent. Simultaneously, there was a boom in the real estate market for both commercial and private property (Vale, 2004). Private consumption and investment increased dramatically, along with asset prices. Increasing asset prices, in turn,

helped fuel the expansion of bank lending since it was possible to get loans in proportion to the value of assets. The banks, on their part, required more liquid means in order to being able to grant a larger volume of loans to businesses and consumer. According to Steigum (2004) the lending boom was funded by short-term borrowing from abroad and liquidity loans from Norges Bank. In other words, the banking system needed more liquidity than what was available internally. Graph 1 illustrates the elevated real estate prices prevalent in Norway between the time of financial deregulation and when the general economy started to deteriorate. Note especially the more than doubling of commercial property prices, in real terms, in Oslo from 1982 to 1987. Such explosive growth partially justified the increased bank lending to businesses at the time. As long as real estate prices were expected to increase also in the future, there was enough collateral relative to debt in the market.

Graph 1: Norwegian real estate prices deflated by CPI.



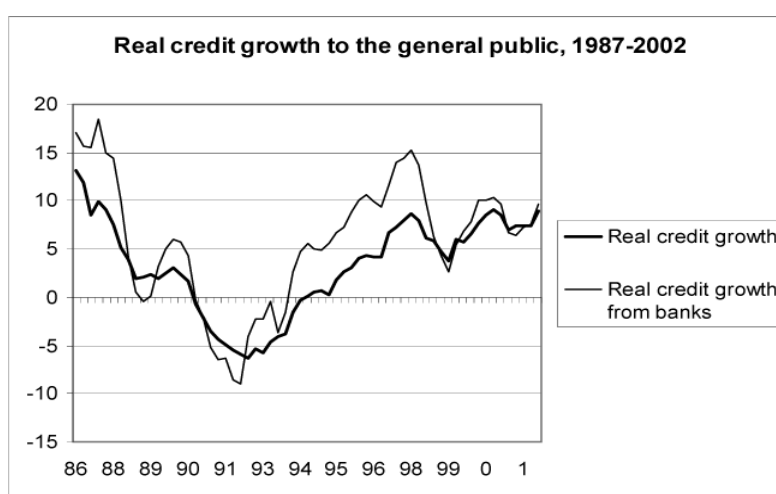
Source: Steigum (2004).

Graph 2 shows how the growth in bank credit closely followed the evolution of commercial real estate prices. Peaking at the time before the banking crisis and reaching the bottom as the crisis turned systemic in 1991-1992, at which point bank credit was actually contracting by ten percent. The drop of almost thirty percent in lending growth during the banking crises clearly illustrates how problems in the banking system can result in an aggregate credit crunch, something that will be discussed later using the model by Holmström and Tirole (1997). It is also clear, from looking at graph 2, that the development in supply of credit from banks closely resembles that of total real credit growth in the market.

One other important restriction that was lifted, at the time of financial deregulation, was the banks' previous inability to establish new branches wherever they wanted in the country. When geographical expansion suddenly became possible, the result was an intense competition for market shares. Banks tried to improve their positions, not only by increasing the volume of

lending at a national level, but also by becoming the dominant local actor in new locations. Many managers of newly opened branches were eagerly granting loans in order to outcompete other contestants, despite a lack of local knowledge and thus without the necessary quality controls. The compensation scheme for many branch managers was designed in such a way so that earnings were based on lending growth (Vale, 2004). The quantitative regulations of the Norwegian banking industry to control aggregate credit supply had worked as a substitute for monetary policy while they were in place. Capital reserves were kept very low, since the risks involved in bank lending were so modest at the time.

Graph 2: Norwegian real domestic credit growth deflated by CPI.

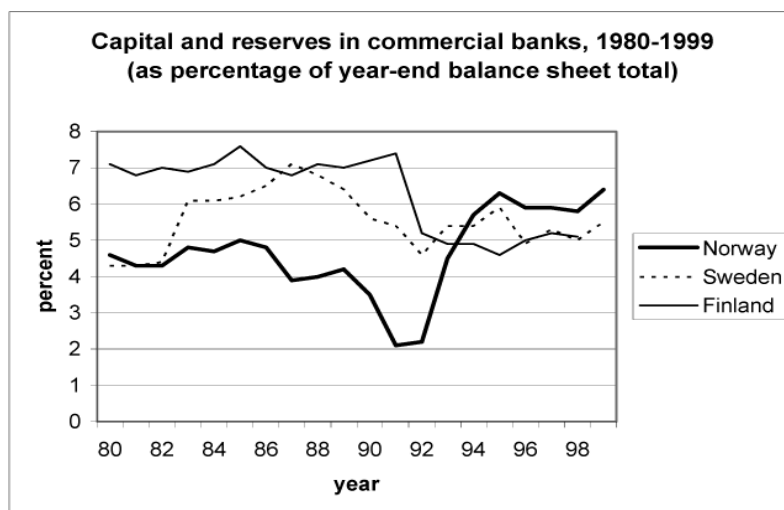


Source: Steigum (2004).

There had even been a relaxation of capital requirements since the early 1970s. Satisfactory capital requirements are presently considered important for the stability of a competitive banking industry because they allow banks to absorb loan losses, hence acting as buffers against insolvency. In order to be effective in this respect, they should be easy to write down to avoid liquidation (Norges Bank). As Norwegian banks faced a new market situation, with a higher level of competition, they did so with a small amount of easily down writable capital. From graph 3, we can see that reserves were reduced even further after the deregulation of the financial markets. This trend should arguably have been the opposite to compensate for the increased loan loss risks entailed in a more competitive environment. In addition, as stated by Vale (2004), the regulatory body approved perpetual subordinated debt as an adequate alternative to equity for fulfilling capital requirements. The decision followed strong demands from the banking industry which needed financing to maintain the high growth in bank lending. Subordinated debt is debt which ranks after other debt, should a company fall into receivership or be closed. This means that, in the case of liquidation of a business endeavor, the

holder of such debt is only repaid after the liquidator, tax authorities, and senior debt holders have been compensated. Although subordinated debt precedes stockholders in the hierarchy of repayment, it is necessarily quite risky since the liquidation value of a company might be too small in order to compensate all lenders. Its issuance is therefore a quite expensive source of finance for a bank since investors demand a high rate of return as a risk premium.

Graph 3: Capital reserves in Scandinavian commercial banks.



Source: Steigum (2004).

The most relevant drawback however, is that subordinated debt is not particularly effective at absorbing losses. A degradation of bank capital works indirectly in the same way as reducing the amount of loss absorbing capital. The substitution of tier I capital for subordinated debt during an economic boom might therefore have serious consequences for a bank during a subsequent recession if it has to cope with some significant losses on its assets. Capital reserves were in fact not increased until after the banking crisis had ended. The issue of, what kinds of capital are considered safe enough to count as reserves is a work in progress for regulatory agencies, and new multinational guidelines are currently under development with Basel III. I will return to this later in the paper.

### 2.3 From boom to bust

Traditionally, systemic banking crises do not occur autonomously, but are triggered by negative shocks to the economy. A downturn in the business-cycle does not automatically entail significant problems for banks, but in the Norwegian case it turned out to be a necessary and sufficient condition for crisis. The lending boom following from the deregulation of the financial markets, combined with the fixed exchange rate regime in place at the time, left the Norwegian economy very exposed to adverse shocks (Steigum, 2004). Allen and Gale (1999)



write that asset bubbles usually occur when present credit levels are high and when future credit levels are uncertain, but the market expects them to increase. They note that this generalization is consistent with bubbles following financial deregulation. The Norwegian development towards a less restricted and market-oriented financial system caused both a credit expansion as well as uncertainty about future credit levels.

The Norwegian economy is quite reliant on the price of oil, and in 1985 this fell sharply. Despite this, the business-cycle reached its height at the end of 1986 and the strength of the downturn during 1988-1989, triggering the banking crisis, came as a surprise (ibid). As the economy went from boom to bust, the real estate bubble also burst. Clients who had been able to borrow money from banks against the increasing value of their property were suddenly in a bad shape for repayment. The high interest rate on central bank loans, causing high market interest rates, worsened an already stressed situation. The fixed exchange rate regime in place at the time caused monetary policy to become pro-cyclical. There was little control of international capital movements and so, monetary policy could not be used to stabilize domestic demand.

The Norwegian currency was pegged to the Deutsche Mark and in Germany, reunification of east and west made the economic priorities there very different from the ones in Norway. In addition, Norges bank was reluctant to devalue the NOK, hoping to improve its credibility in the international currency market. Lax reserve requirements along with a new competitive environment and a central bank focused on defending the fixed exchange rate, made the banking industry very vulnerable to negative macroeconomic shocks. Steigum (2004) writes in his paper, that the combination of a fixed exchange rate and financial deregulation was the most important cause of the Norwegian Banking crisis. In other words, although the expansionist strategy of commercial banks did not facilitate the crisis on its own, it contributed to the problem by making the banking system more exposed to fluctuations in the business-cycle. The situation was not helped by Norges Bank's inability to ease the situation through a lowering of the central bank interest rate. In fact, the fixed exchange rate policy forced all of the Nordic central banks to keep interest rates very high, instead of fighting recession by providing much needed stimulus to the economy.

An alternative to monetary policy is of course financial policy, like for example tax breaks. Financial policy is hard to implement at a short notice however, since changes in legislation typically has a long inside lag. A high central bank interest rate implies a high rate on interbank loans, and typically also a high market rate. Either way, banks' profits from interest rate spreads will erode if lenders are unwilling to accept more expensive loans. Hence,

monetary policy contributed to deepening the troubles in the financial markets. In addition to this, there had been a postponement of several problems in the 1970s, and Norwegian economic policy was presented with vast challenges at the beginning of the 1980s (Steigum, 2004). While the deterioration of the private housing market was part of pressuring the banking industry, the largest losses came from loans to businesses. Some individual small and medium sized banks got into trouble before the crisis became systemic, and so there was a fear that the problems might spread to larger, more important banks.

## **2.4 Government intervention**

Vale (2004) writes that almost a quarter of commercial bank lending was to foreign investors in the early stages of the crisis and the Norwegian government had to restore market confidence to prevent an outflow of foreign capital. Such a flight of capital would have left Norwegian banks with significant liquidity problems. The height of the crisis materialized in the years 1991-1992 at which point it was systemic and the Norwegian government had to intervene on a large scale. Shares of key domestic banks were written down to zero and as a result the government, considering them too large to fail, ended up as a major or sole owner of last resort. In March 1991 the Government Bank Insurance Fund was established and initially capitalized with five billion NOK. Only a half year later, another six billion had to be injected into the fund. This was done to restore confidence in the banking industry.

At approximately the same time Christiania Bank, the second largest Norwegian bank, publicly announced that its entire equity capital was lost. The government responded quickly by pledging to provide additional share capital to avoid bankruptcy. Later, both the largest Norwegian bank, DnB and another significant actor, Fokus Bank encountered similar problems and the government had to get involved once again. The reason, according to Steigum (2004), as to why the shares of Christiania Bank and Fokus Bank were subsequently written down to zero, was their high losses and a lack of confidence in their continued stability from private investors. The shares of DnB were initially written down by 90 percent and then finally all the way down to zero in 1992. In under a year, the Norwegian government had become the dominant owner of DnB and the sole owner of Christiania Bank and Fokus Bank. In the years following the banking crisis, the value of the governments shares increased substantially and it actually ended up profiting on the rescue operation by diminishing its ownership positions.

The Norwegian government believed that the banking industry would have to be brought back to full functionality for the aggregate economy to recover and was hence able to effectively prevent the crisis from having a more profound effect on the real economy. In Japan

during the 1997 crisis of the East Asian economies, the assumption was the opposite, namely that when the macro situation improved, the credit markets would recover. Allen and Gale (1999) argue that the lack of intervention by the Japanese government caused the crisis to be much more long lived than the Norwegian one, to an extent legitimating the government ownership described above. It would appear that a solution to the banking problem is required to restore economic growth. Steigum (2004) claims, that it is unclear whether the presence of a strong bank supervisory authority during the lending boom could have dampened the severity of the subsequent crisis. He notes however, that a stricter capital adequacy requirement for Norwegian banks could have strongly reduced its magnitude or perhaps even led to its avoidance altogether. In the next chapter, we will see that the intensified fragility of the banking industry resulting from weak capital reserves was a recurring theme also during the recent financial crisis.

### 3 The subprime financial crisis 2007-

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The recent financial crises came about after many years of international economic growth. Simultaneously there had been a general underestimation of risk in the financial markets. The economic development prior to the crisis was characterized by low interest rates paired with a significant appetite for risk from investors who only suffered minor losses. The combination of these factors laid the foundation for an increasing debt, in addition to booming asset prices and property prices in the US and several European countries. The growing debt of many industrialized economies was partly financed by capital flows from emerging economies with a high propensity to save (Norges Bank, 2008). China was and still is the most important emerging economy with its astounding average annual GDP growth of almost 9 percent for the preceding decade.<sup>1</sup> This European and American dependence on emerging economies contributed to significant imbalances in the world economy. Large foreign exchange deficits in industrialized and already indebted countries, most notably the US, were made possible through comparable surpluses in emerging economies.<sup>2</sup> During the same period, the prevalence of low risk premiums in the financial markets boosted a strong, market financed, growth in the balance sheets of banks while regulatory shortcomings allowed financial institutions to operate with a very small share of equity capital (ibid).

The financial crisis was eventually triggered in 2007 by failings in the US property markets. Due to interwoven financial markets, the problems spread quickly to other overextended economies. Liquidity in the interbank markets dried up as the perceived credit risks suddenly increased. At the beginning of the crisis, central banks injected short-term liquidity into the banking systems to prevent solvent banks from experiencing large financing problems. These measures soon proved insufficient however and more extensive rescue packages had to be designed (ibid). I will return to the resolution of the financial crisis in Norway later.

#### 3.1 Securitization and risk taking

Although a rather complicated subject, it is impossible to cover the financial crisis without mentioning the fairly modern practice of securitization. Prior to the subprime crisis in 2007,

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<sup>1</sup> Average GDP growth in China adjusted by inflation from Sept. 1997 to Sept. 2007 was 8.84 percent. Data from: <http://www.tradingeconomics.com/Economics/GDP-Growth.aspx?Symbol=CNY>

<sup>2</sup> As of June 30, 2009, accumulated US foreign debt stands at \$13,450,000,000,000. Data from: <https://www.cia.gov/library/publications/the-world-factbook/rankorder/2079rank.html>

many traditional banks managed to boost their borrowing and lending activities without violating minimum capital requirements, by adopting the “originate and distribute” banking model. Traditionally, commercial banks held loans on their balance sheets and were directly subjected to their risks. In the “originate and distribute” model the loans are pooled together, made into financial products and resold via securitization to a third party (Brunnermeier, 2009).

There are several classes of asset backed securities (ABS). Their risk and value depend on their relation to, as well as the quality of, the underlying asset pool. Mortgage backed securities (MBS) are financial products constructed from a more or less diversified group of mortgages with various expectancy of default. These naturally became widespread throughout the banking industry since banks are the prime granter of such loans. At the end of 2006 the nominal value of American mortgages was approximately \$ 10 200 billion and about 55 percent of these were used as collateral for securities sold to investors around the globe. The market for securities backed by American mortgages prior to the financial crisis was in fact larger than the market for American government bonds and represented more than 10 percent of worldwide securitized debt. 12-15 percent of securitized mortgages were categorized as subprime, meaning that they had a relatively high risk of default (Norges Bank, 2007).

A particular class of ABS's that has been widely mentioned in relation to the financial crisis is referred to as collateralized debt obligations (CDO). The simplified process of issuing CDO's is as follows: A bank constructs and values a pool of mortgages. It can then sell the claim to these loans as a bond to a special purpose vehicle (SPV). SPV's are often created by banks and their sole function is to trade in securitized paper. In fact, an important reason for the development of SPV's was a loophole in the old Basel I regulations, which allowed them to operate independently of the banks from which bonds were bought. Neither were they subject to financial supervision or capital regulations. This enabled banks to move a considerable amount of risky loans off their balance sheets. Initially many SPV's also enjoyed solid credit ratings, although these necessarily suffered when the economic boom ended and the perceived risks of ABS's increased (Norges Bank, 2007). An SPV finances its investments by deconstructing and reselling the asset backed securities to investors. One important trait of a CDO is that the claim to the underlying asset pool is often divided into tranches with different risk profiles. The three main categories of tranches are; senior tranches, mezzanine tranches and junior- or equity tranches. The safest of these securities, included in the senior tranche, promise to pay out their owners first in case of defaults or lacking repayments in the mortgage pool, and hence they often receive AAA ratings. The equity and mezzanine tranches are far more risky.

In a representative example they might be valued at 10 percent of the CDO, but are subject to 90 percent of the underlying risk (Rakkestad and Weme, 2006). Investors willing to buy such paper would typically require a high rate of return. If the CDO is viewed as similar to an insurance policy, this would translate to high risk payments to the investor and a low premium in case of default. Without going into specifics, there are several types of CDO's. A cash flow CDO pays investors when mortgage payments occur on time and is thus directly tied to the profitability of underlying mortgages. A synthetic CDO is more complicated since the SPV does not acquire the securitized mortgage portfolio, but rather credit derivatives. The construction of CDO's became so complicated in some cases that rating agencies struggled to determine their true value. In addition, many tranches were designed to barely meet the requirements for an AAA rating and these were quickly downgraded once the economic situation deteriorated. Uncertain valuation became a source of much distrust during the financial crisis and rating agencies were accused of having rated securities too optimistically (ibid).

Simultaneously as securitization became increasingly popular in the banking industry, there was a blending of traditional bank activities and investment banking. Investment banking is different from commercial banking. Commercial banks offer various corporate financial services that attend to the specific needs of private venture. They mainly convert short-term deposits into long-term loans. However, they will not service investment activities in financial markets. An investment bank on the other hand is more similar in nature to a mutual fund. It attracts investment from the market and uses these funds to invest in a wide range of enterprises, industries and financial markets. Where the two forms of banking used to be separated they now became merged.<sup>3</sup> One consequence of this development was that universal banks also speculated in asset backed securities, meaning that banks ended up holding part of the risk that securitization had allowed them to get rid of in the first place.

### **3.2 Crisis and credit crunch**

The “originate and distribute” model led to a decline in lending standards as the ability to transfer risk by selling mortgage backed securities to a third party led to an unprecedented credit expansion. The credit expansion in turn, helped fuel the boom in housing prices (Brunnermeier, 2009). As long as both aggregate credit and housing prices were increasing simultaneously, the gearing of banks' balance sheets was allowed to go on. Credit availability

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<sup>3</sup> The Gramm–Leach–Bliley Act of 1999 allowed commercial banks (referring to traditional banking activities), investment banks, securities firms, and insurance companies to merge. Naturally many banks did. The combination of commercial banking and investment banking is commonly referred to as universal banking.

ensured that the housing bubble could continue to expand, while the increasing housing prices kept the risks of the MBS's issued by banks relatively low. This development bears a strong resemblance to the previously described situation in Norway prior to the Scandinavian crisis almost two decades earlier. Knowing about business-cycles, and drawing on past experiences with bubbles, it is clear that this practice could not possibly persist, but in an intensively competitive banking industry there was a resistance towards backing out of the process before the risks started to manifest themselves as increased losses.

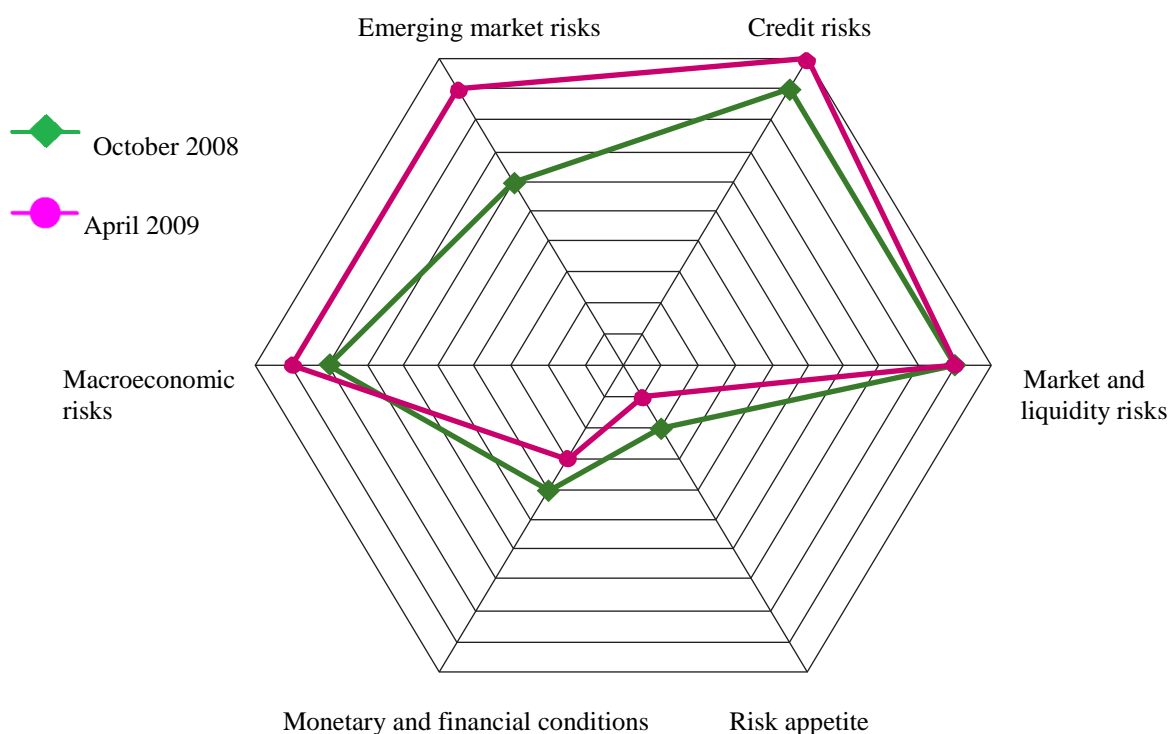
The industry average earnings a bank manager generates typically works as a benchmark for the quality of the individual manager's performance. He is thus held responsible if the revenues produced by his bank, are less than those of comparable bank (Diamond and Rajan, 2009). The short-term incentives, in an industry where performance-based compensation is common practice, are in other words not compatible with safety and longevity. Citigroup Chairman Chuck Prince has been widely cited for his quote to the Financial Times on why his bank kept financing buyouts despite mounting risks. "When the music stops, in terms of liquidity, things will be complicated. But as long as the music is playing, you've got to get up and dance. We're still dancing" (Financial Times: July 10, 2007). Arguably the music had already stopped at the time his quote was published.

The crisis was triggered by an increased delinquency rate in the American market for mortgages to borrowers with a low credit rating, also known as subprime mortgages. Generally, a loan is deemed delinquent when payments are three or more months overdue. Private borrowers had been able to get mortgages, sometimes without collateral or a reliable source of income, since the future market prices of their housing investments were expected to increase. Naturally, the risks of granting such loans are high and strongly tied to market fluctuations. The market for subprime loans expanded rapidly over the first half of the previous decade. The share of American mortgages categorized as subprime increased from 8 percent in 2001 to 20 percent in 2006. Meanwhile, the share of subprime mortgages that had been securitized grew from 54 percent to 75 percent and the general quality of the market had fallen significantly and continuously in the process (Demyanyk and Hemert, 2009). The disturbances spread to the money and credit markets when it became clear that several banks in the US and Europe would have to include loss bearing loans on their own balance sheets (*ibid*). The loans were brought back onto the balance sheets due to reputational concerns and financing problems and once there, they became subjected to capital requirements. Uncertainty concerning the true value of complex securities and the financial situation of their owners, as well as generally reduced expectations about future economic growth, caused market liquidity and financing to

contract. Norwegian banks did not have any unregulated off-balance-sheet assets, but their lending growth was still significant, which made them exposed to the effects of market fluctuations (Norges Bank, 2009). Financial institutions without any investments in the market for American subprime mortgages were affected by the crisis due to this reduced liquidity in the money markets (Demyanyk and Hermert, 2009).

The financial crisis had, with the benefit of hindsight, many predictable boom-bust characteristics. It was preceded by a significant credit expansion, as well as growth in property markets and the stock market. Both financial markets and countries had become heavily dependent on borrowing against future income and increasing asset prices. The crisis itself came about as the economy was slowing down and stocks and properties were written down to their true underlying values, realizing the postponed investment risks of the preceding period. The turmoil in international markets has caused serious problems for banks through at least three channels: Losses stemming from investments in securities, increased loan losses and finally, an insufficient supply of liquidity from the credit markets (Norges Bank, 2007). Figure 1 shows an overall assessment of the risks and conditions in global financial markets. The further from the middle a point is located the higher its value.

Figure 1: Risks and conditions in global financial markets



Source: IMF (2008).



### 3.3 The Norwegian experience

So far, Norwegian banks have fared better throughout the financial crisis than many of their foreign counterparts and this notion is attributable to several factors. Prior to the crisis, Norwegian banks experienced a period of prolonged growth and they have maintained their solidity with assistance from the government. The losses stemming from their lending activity have materialized later than in other countries. This is partly due to Norway's strong economy, but also because the Norwegian banking sector only constitutes a small share of GDP compared to the banking sectors in other industrialized and even Scandinavian countries. Furthermore, the activities of Norwegian banks abroad are quite limited which may have contributed to curtail contagion (Norges Bank, 2008).

Securities in general do not account for a large fraction of the assets owned by Norwegian banks, as they mainly invest by lending to households and firms. An important reason for this is simply that the nationally owned share of the Norwegian banking system consists of many small and a few medium sized banks that are prevented by their size of operations from competing in financial markets on a major scale. DnB NOR, the largest Norwegian bank, which has a substantial trading portfolio is an exception. The low and volatile stock prices caused by the financial crisis, had an adverse effect on DnB NOR's solvency gap as well as that of Nordea, which although a Swedish bank, has the second largest market share in Norway (Norges Bank, 2009).<sup>4</sup> The majority of the Norwegian banking system avoided such problems however and even though the crises eroded much of the down writable equity issued by banks through stocks and bonds on their liabilities side, the aggregate losses from asset securities were modest. As a representation of the dramatic deterioration of financial papers caused by the crisis, the Norwegian stock market main index (OSEBX) plummeted from a near all time high of 522 points on the 22<sup>nd</sup> of May 2008, to a mere 190 points on December 5<sup>th</sup> of the same year, a 64 percent drop.<sup>5</sup> The banks also successfully avoided any involvement with subprime securities and were therefore not directly exposed to the heavy losses associated with American MBS's (Norges Bank, 2008). They were generally neither involved in investment banking activities like their larger American counterparts, causing them to be less affected by the drastic changes in the international financial markets, although DnB NOR, again being the exception, had to take a write down because of subprime (Werdigier, 2007).

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<sup>4</sup> The solvency gap is how many standard deviations the value of a bank's assets can fall before its capital requirement is violated.

<sup>5</sup> Numbers from OSEBX graph at <http://www.euroinvestor.no/stock/chart.aspx?id=340348>

It deserves a mention that Norwegian banks themselves had used a type of securitization to finance their lending growth since June 2007. At that point in time the banks were allowed to issue covered bonds using mortgages and loans to businesses as collateral, but these financial instruments are not to be confused with asset backed securities like the CDO's mentioned earlier. The Norwegian version of covered bonds, are called OMF.<sup>6</sup> They provide an investor with a senior claim to a pool of the bank's assets and are sold through a credit institution. The institutions involved in the trading of OMF are subject to the same regulatory and supervisory framework as banks and are therefore quite different from SPV's involved in the securitization of subprime mortgages. Furthermore unlike CDO's, the OMF are not divided into tranches and there are strict regulations concerning their underlying pool of assets. The asset pools mainly consist of mortgages and loans to businesses where the borrowers' debt cannot exceed 75 percent of the collateral's value (Bakke and Rakkestad, 2010).

OMF can usually be issued to investors on better terms than bank bonds or unsecured loans since they are considered relatively safe investments. An OMF that is deemed to be of a satisfactory quality and meets the detailed conditions of the Capital Requirements Directive also gains a low risk weight of 10 percent, which means that their issuance enable banks to increase their lending while maintaining a low level of equity capital (ibid).<sup>7</sup> These two useful features quickly made OMF's a popular source of financing for banks and in 2010 their aggregate value stands at approximately 470 billion NOK. Although the Norwegian market for OMF is still in its infancy, it has proven robust during the financial crisis and as an optional source of financing for banks, OMF have contributed to financial stability (Bakke and Rakkestad, 2010). OMF's have also enabled a higher lending growth from banks however, which may contribute to pro-cyclical banking and credit supply, but the quality regulations in place prevents unrestricted lending to borrowers. The fact that investors have the senior claim to some of the banks safest assets may be a cause for concern. If property prices fall like they did during the financial crisis, the value of an OMF may follow suite if many of the underlying loans suddenly exceed 75 percent of the reduced collateral and have to be removed from the pool. An important distinction between ABS's and OMF is that, while both enable banks to increase their lending activities, OMF do not remove the asset risks from the balance sheets of banks and therefore does not encourage risk seeking behavior in the same way as normal securitization.

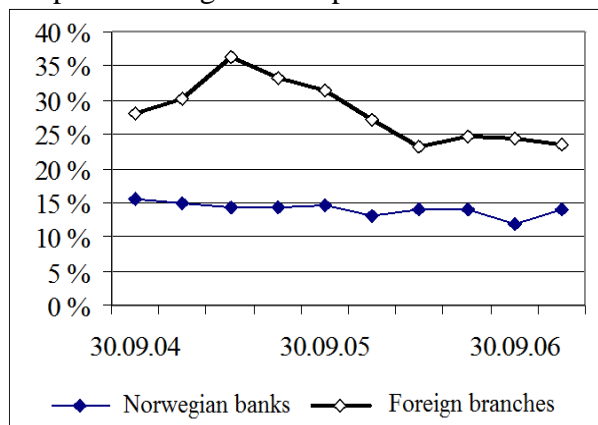
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<sup>6</sup> OMF stands for: Obligasjoner med fortrinnsrett (plural).

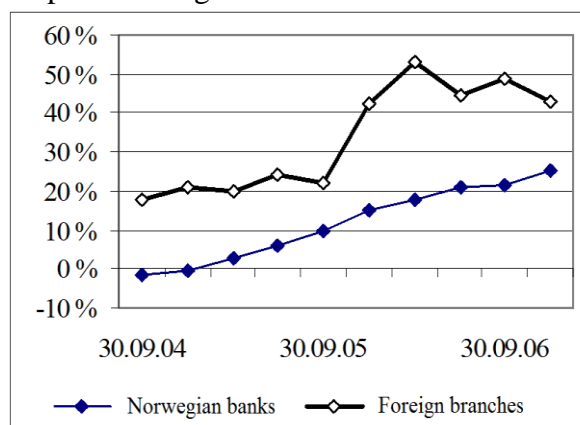
<sup>12</sup> The CRD is a set of guidelines from the EU concerning how much equity capital a credit institution must hold in proportion to its various categories of assets. Assets are given different weights depending on their risk characteristics. A relatively safe asset gets a low risk weight (Bakke and Rakkestad, 2010).

One of the main concerns for Norwegian banks during the financial crisis was their need to renew their financing. During the crisis it became difficult for the banks to obtain credit in the market. This posed a problem since market financing had developed into an important source of funding as the banks' lending growth had exceeded that of deposits for several years (Finanstilsynet, 2006). Their dependence on private investment exposed the banks to the disturbances in the international credit markets brought about by the subprime crisis. Especially banks that had based their operations on a large share of short-term financing and had significant asset shares in economic sectors exposed to losses, experienced difficulties trying to renew these loans (Norges Bank, 2008). Under normal market conditions, short-term financing is cheaper than long-term financing. The intuition behind this is simply that the uncertainty of future repayment increases with a longer time to maturity. Investors need to be compensated for unforeseen circumstances, through a risk premium and the distant future is necessarily more difficult to predict and therefore requires a higher premium. Simultaneously, investments that are tied up cannot be used to exploit market opportunities which increase investors' opportunity cost of providing long-term financing. To support their lending growth prior to the financial crisis it was thus profitable for the banks to use short-term funding, which was easily accessible while the lending boom lasted. As boom turned to bust, access to both long-term and short-term financing dried up, but the largest problems were naturally associated with the short-term financing since it was more likely to require renewing while the crisis lasted. If a bank struggles to obtain funding, it will have to rein in on its own lending activities, which in turn can have serious effects for businesses heavily reliant on bank loans. During a credit crunch it can therefore be both difficult and expensive for businesses to get loans and firms that need to refinance their debt encounter obstacles in the credit market. Norwegian banks did in fact reduce their lending to firms during the crisis and they also announced that they would prioritize existing customers over new applicants when supplying credit. Many firms were also denied debt financing in the securities market (Norges Bank, 2009). This relates strongly to the theory by Holmström and Tirole (1997) to be presented later. The graphs below illustrate the significant loan volume growth for banks with both foreign and Norwegian ownership prior to the crisis: Graph 5 is for private customers and graph 6 is for business customers.

Graph 4: Loan growth to private customers



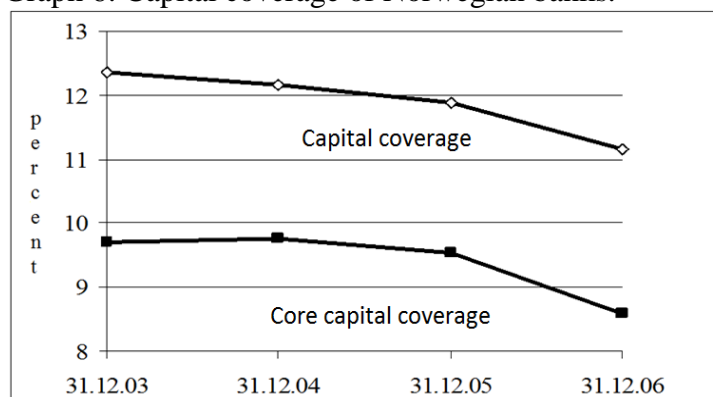
Graph 5: Loan growth to businesses



Source: Finanstilsynet (2006).

Both graphs show a notable increase in loan volume growth to businesses from Norwegian banks before the financial crisis in 2007, although exceeded by that of foreign branches during the same period. Simultaneously, as can be seen from graph 6 below, there was a reduction in Norwegian banks of both total capital coverage and core capital coverage.<sup>8</sup> The aggregate core capital coverage for the Norwegian banking industry was 8.6 percent at the end of 2006. Total capital coverage was at 11.2 percent. All of the banks satisfied the demand for minimum capital coverage, which was at 8 percent and only five banks had core capital coverage lower than 8 percent. During the crisis, many banks sought to strengthen their core capital to improve their access to financing through bonds. This required a higher income, which depositors and lenders had to pay for through low interest rates on deposits and a high interest margin on loans (Norges Bank, 2009).

Graph 6: Capital coverage of Norwegian banks.



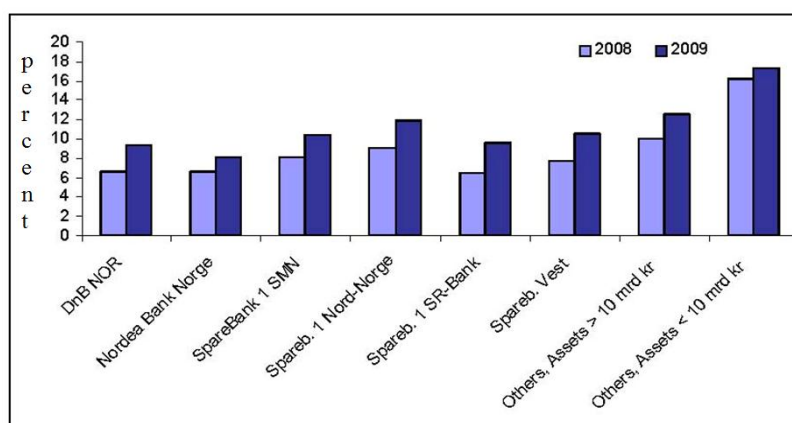
Source: Finanstilsynet (2006).

Graph 7 on the next page shows the evolution of capital shares in major Norwegian banks in the wake of the financial crisis. The share is similar to 2006 levels, but it is important to

<sup>8</sup> Core capital coverage is a mixture of equity and accepted hybrid capital. It is a risk weighted measure of a bank's solvency and should be easy to write down when asset values are reduced (Norges Bank, 2009).

remember that the banking industry is still in a state of recovery, meaning that we will have to wait for some time before we might see a change in the “business as usual” capital levels. The graph also shows a uniform increase in capital levels from 2008 to 2009. As illustrated in graph 4 and 5, the growth in deposits from private customers prior to the financial crisis was 15.6 percent in 2006, while the growth in deposits from business customers was particularly high. The strong growth in the total volume of deposits was, however, not sufficient in order to prevent a deterioration of the deposit coverage for loans to customers. From graph 8 one can see a clear downward trend in the deposit volume-to-loan volume ratio, reaching its lowest point at 62.3 percent in 2006. The very favorable macro situation in the years prior to the financial crisis contributed to a continued reduction in loan defaults in 2006. The gross default rate on loans to customers was only 0.6 percent by the end of the year. By 2008 the banks’ loan losses started to increase and by the end of the year, they had put aside considerable means to counter further future losses from highly exposed industries like shipping. The number of defaults from loans to businesses did indeed increase in the first quarter of 2009 before starting to diminish later in the year (Norges Bank, 2009).

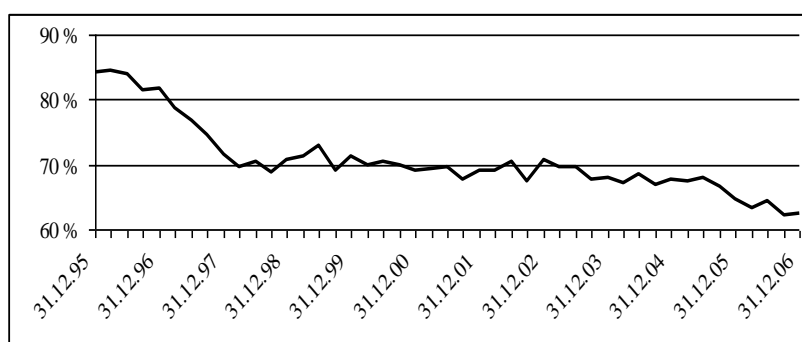
Graph 7: Capital reserves in percent for large Norwegian banks.



Source: Finanstilsynet (2006).

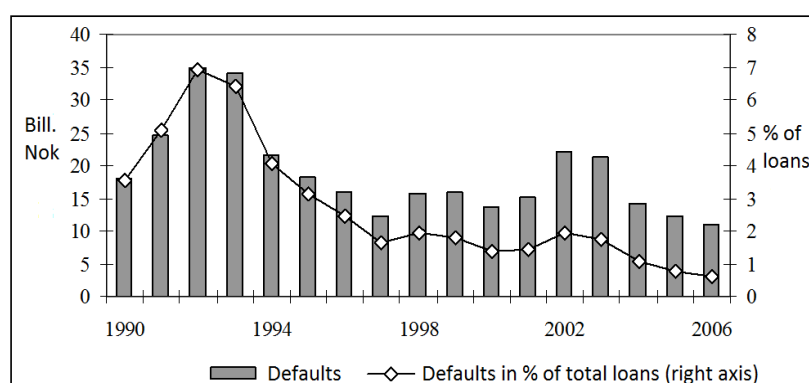
All these numbers seem to a hypothesis of pro-cyclical banking not only prior to the Norwegian banking crisis at the end of the 1980s and early 1990s, but also before the latest financial crisis. Whether the low amount of loan defaults in 2006 means that the aggregate portfolio of Norwegian bank loans was relatively safe under normal conditions, or whether there was simply a postponement of risk due to the favorable macro situation, is hard to tell from these numbers alone.

Graph 8: Deposit coverage for loans for Norwegian banks.



Source: Finanstilsynet (2006).

Graph 9: Percentage of loan defaults.



Source: Finanstilsynet (2006).

### 3.4 The Terra scandal of 2007

Even though Norwegian commercial banks avoided involvement in American mortgage backed securities speculation, there was a serious incident involving several local governments and an investment company in the fall of 2007. Four Norwegian municipalities had invested heavily in collateralized debt obligations created by Citigroup and sold through the investment company Terra Securities. Terra Securities was the investment banking arm, owned by the Terra Gruppen which is jointly owned by 77 local savings banks according to their website<sup>9</sup>. The group is frequently used as the main supplier of financing for local communities in Norway and in 2007 it had a market share of 6.5 percent of the Norwegian banking market.

The securities themselves were very complicated, but were essentially derived from US mortgages in the way I described earlier and subject to significant gearing increasing the investment risk. The municipalities of Narvik, Hattfjelldal, Rana and Hemnes had invested a total of 451 million NOK. In the end, 350 million NOK were lost as the investments plummeted to 55 percent of their original value (Werdigier, 2007). What made this episode particularly controversial was the fact that the municipalities had used future income from local

<sup>9</sup> Terra Group website: <http://www.terra.no/Sider/default.aspx> The scandal is summed up in a four-word sentence.

energy production as a source of financing. After the investment was sunk, they had essentially bankrupted themselves and in addition temporarily interrupted important future income. To set an example, the Norwegian minister of finance at the time said that the centralized government was unlikely to bail them out (ibid). As is to be expected after such an event, there was a prolonged search for someone to take the blame. The municipalities' representatives claimed to have been wrongfully informed, during presentations by Terra, about the true risk of the securities they had bought, and they even tried to sue. Terra Securities was eventually closed down due to its tainted reputation. Truth be told, the municipalities had made a serious gamble with public resources, gearing an already risky investment through lending.

### **3.5 Government intervention**

The central bank and the government made several efforts to improve liquidity and alleviate the impact of the financial crisis on Norwegian banks and the financial system in general. Some of the most notable measures were; the lowering of the central banks interest rate, an increase of longer term loans from the central bank, an arrangement to swap OMF against government bonds and the formation of two government investment funds. DnB NOR also received large capital injections.

Since government bonds are more easily traded than OMF, the government's offer to let banks swap OMF for government bonds improved their liquidity situation. By May 2009, 230 billion NOK had been distributed in bonds through auctions administered by the central bank (Bakke and Rakkestad, 2010). Because the assets used as collateral for OMF had been subject to strict qualitative regulation, the swap arrangement did not involve any serious gamble with the taxpayers' money, but functioned as a temporary improvement of the strained liquidity situation in the banking industry. The need for the swap arrangement has diminished as the ability to issue OMF in traditional investor markets has improved (ibid).

To provide banks with a stable source of credit, the central bank increased its issuance of F-loans to the industry. An F-loan is the primary instrument used by the Norwegian central bank to provide liquidity to the banking system and has a longer time to maturity than regular overnight loans. They are given against collateral in the form of securities and have an ex-ante specified rate of interest and maturity. The maturity differs in accordance with the liquidity situation in the banking system. The interest rates on F-loans are normally determined by

multi-price auctions. Norges Bank decides the aggregate amount of loans to be provided and the banks' interest rate bids are ranked in descending order.<sup>10</sup>

The two government funds that were formed, namely Statens Finansfond and Statens Obligasjonsfond each received 50 billion NOK in capital to invest in financial instruments from banks, as well as from other financial and non-financial institutions. Its mandate was to firstly invest in instruments from institutions with a high credit rating. Once again, the goal was to improve the liquidity situation in financial markets (Norges Bank 2009). A regulatory rule of thumb for public intervention in financial markets is that institutions should be aided against illiquidity, but not against insolvency. Problems arise when an insolvent institution is considered to be too large to fail, because its liquidation will have severe adverse effects on the economy. I will return to this topic later.

A low central bank interest rate allowed banks to earn increased risk premiums on their lending interest rate, while keeping deposit rates low. This measure improved liquidity in the interbank market in which the perceived counterparty risk was high. Initially during the crisis, risk premiums were sizable, but due to government and central bank interventions the interest rates on loans started to come down (ibid).

### **3.6 Developments in international banking regulation**

In 1991 Norway implemented the first guidelines from the Basel Committee, the Basel I accord. The accord was subsequently adopted by the Group of Ten in 1992,<sup>11</sup> With Basel I, banks were subjected to capital requirements of at least 8 percent and the requirements for an individual banks were tied to the risks associated with that banks' assets, for example its loans (Norges Bank, 2009). In 2007 the transition to Basel II began and soon after on November 20. 2008, drawing on the experiences of the financial crisis, the Committee adopted a strategy to rectify apparent weaknesses in financial regulation, monitoring and the risk managing in banks. The goal was to improve upon the Basel II framework and more attention was devoted to bank assets that are held off the balance sheets and liquidity risk (ibid). Basel II had attracted criticism for possibly contributing to pro-cyclical banking. It had put a larger emphasis than Basel I on tying capital requirements to measured asset risk.

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<sup>10</sup> Information on F-loans from Norges Bank's homepage:  
[http://www.norges-bank.no/templates/article\\_\\_\\_\\_69602.aspx](http://www.norges-bank.no/templates/article____69602.aspx)

<sup>11</sup> The Group of Ten (which had eleven members at the time) refers to the following economies: The United States, the United Kingdom, Japan, Germany, France, Italy, Canada, the Netherlands, Belgium, Switzerland and Sweden (Source: IMF).



During economic booms asset risks are perceived to be relatively low, as was the case prior both the Norwegian banking crisis and the financial crisis for several consecutive years. When the economy is finally slowing down, the asset risks increase. A capital requirement strictly tied to present or past asset risk does not necessarily account for the effects of a strong recession like the financial crisis. It can therefore become pro-cyclical as it prescribes banks to increase their capital levels during recessions rather than periods of strong economic growth (ibid). Currently the Basel III accord is being developed, in addition to the augmentations for the CRD as the new international framework for bank regulation, and presently there are suggestions that banks should build up capital buffers during booms to counter future losses. Capital requirements will still be related to asset risks, but the risks should be calculated as if the economy is growing at an average pace, even if it's booming to prevent pro-cyclicality (ibid). The minimum quantitative capital requirements, as well as the qualitative standards of capital have to be raised to reinforce banks against financial stress scenarios. Banks will have to use periods of economic growth to build up buffers of such capital to be readily available during recessions and they should satisfy an additional minimum capital requirement independently of the risk weighted capital requirement (ibid). In addition to controlling the relative amount of bank capital directly, the committee wants to put restrictions on what it calls unsustainable balance-sheet growth of banks,<sup>12</sup> so that there is a limit to leveraging, or gearing, of capital. That is, how much money in loans and deposits that can be held per unit of capital, in relative terms. As a concrete example, the committee is working on a leverage ratio, measured as high quality capital over total market exposure. In short, the Basel Committee wants to strengthen the level of capital in the banking system to make it more robust, as was made clear in a press release on the twelfth of March 2009.

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<sup>12</sup> A letter from the European Business Council provides an executive summary of developments in the CRD: [http://ec.europa.eu/internal\\_market/bank/docs/ebc/info-letter/200909\\_en.pdf](http://ec.europa.eu/internal_market/bank/docs/ebc/info-letter/200909_en.pdf)

Another summary of Basel II, CRD and future developments can be found here: <http://www.fsa.gov.uk/pages/About/What/International/basel/index.shtml>

## 4 A tentative comparison of the two crises and the road ahead

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The presentations of both the Norwegian banking crisis and the recent financial crisis respectively, form the necessary basis to examine how they compare in a few key areas. Chapter 2 and 3 intentionally focused on variables such as credit, capital, liquidity and asset risk and these variables will also be the center of attention in further discussion. Unlike the resolution of the Norwegian banking crisis which involved a more serious intervention, the Norwegian government did not have to assume ownership of failed banks to keep the system working during the financial crisis. This shows that the financial crisis proved less severe for the Norwegian banking system, but also supports the proposition that the banks had taken a significant step away from the risky investment strategies of the late 80s. The main disturbances stemmed from illiquidity in international money markets and a dependence on short-term financing and not a direct exposure to subprime securities. In terms of pro-cyclical banking, there are some similarities however. Both crises were preceded by periods of economic growth and booming property prices, fueling a considerable expansion of credit. The lending growth from Norwegian banks was also financed by an increasing share of short-term debt in both cases and by issuing OMF since 2007. Once affected by the economic downturns of interest the banks had to rein in on their own lending, thus affecting firms dependent on the access to bank financing.

The organization of Norwegian financial markets was quite different in the late 1980s than in 2007 however. Whereas Norwegian bank managers in the 1980s were exposed to sudden market changes due to financial de-regulation, by 2007 they had grown accustomed to operating in a competitive environment and the most profitable opportunities for new branch expansions had been exploited. The systemic crisis in 1991-1992 had also taught the industry and the regulators a valuable lesson about the possible consequences of banks overextending their lending to risky borrowers. The average capital reserves of commercial banks were increased to strengthen their buffers against insolvency. In international financial markets however, there was an escalation in the use financial innovation. In 2007, the process of securitization which previously had allowed banks to increase their lending and profits became a source of high asset risk and heavy losses. Although regulatory progress, like the adoption of the Basel I framework, paved the way for a safer banking industry, it seems like the banks through the use of financial innovation found, at least to an extent, a way around the restrictions by moving assets off the balance sheet to finance a high lending growth. In addition, previously strictly commercial banks had ventured into investment banking activities and universal banking became more commonplace, although size prevented most Norwegian

banks from such a development. Some macroeconomic differences and similarities also deserve a mention.

The price of oil dropped before the Norwegian banking crisis, and because of the financial crisis. Although the oil price is not directly related to the credit market, the revenues of oil related companies are important to the Oslo stock exchange, and the general shape of the stock market is in turn important for other financial markets and for attracting foreign investment.

An important change that took place in between crises was the abandonment of the fixed exchange rate system. The exacerbation of financial problems caused by high central bank interest rates during the Norwegian banking crisis, as well as a speculative attack against the currency had led to this decision. Norway, like the other Scandinavian countries, currently uses a floating exchange rate regime, and monetary policy focuses on inflation targeting. This conversion allowed Norges Bank to stimulate the economy, by lowering its interest rates during the recent financial crisis. Low central bank interest rates allow banks to profit on high margins, by keeping their own interest rates on lending high. The interest rate on lending is essentially a risk premium and in an interbank market with liquidity problems, such compensation for risk can stimulate lending between banks, as well as to the general public. During the financial crisis, there was a significant lack of trust in the interbank market, especially in the US where it was very difficult to verify which banks were stuck with the worst mortgage securities and liquidity problems.

The financial crisis then caused a widespread problem of illiquidity in financial markets and banking systems around the world. The situation was particularly dire for the institutions that had been heavily involved in subprime securities speculation, but it also made a serious impact on several banks and other financial corporations with no direct involvement, that came under pressure due to local and cross country contagion. This was true in the case of the Norwegian banking system. Financial markets have become increasingly interdependent and more responsive to each other, on short notice, on a global level. This means that the Norwegian banking system not only has to safeguard against stress stemming from local occurrences, but also against shocks coming from abroad. The banking system's sensitivity to fluctuations in international financial markets is of course nothing new, but the speed at which capital flows can possibly shift, makes it even more vital to consider when deciding on sensible levels of reserve requirements and exposure to market-risk for banks. Like the subprime financial crisis clearly demonstrated in the Norwegian case; even a soundly functioning

banking system, situated in a strong economy, can become illiquid as investments in the international markets dry up.

The model by Holmström and Tirole from 1997 to be introduced in detail in the next chapter includes two important features for further analysis. Firstly, it illustrates the unique importance of bank credit for economic efficiency and stability, and secondly, it uses its setup to demonstrate what happens to the credit market when the economy is hit by a shock. Before reading further, it can be helpful to consider the following questions:

Both the Norwegian banking crisis and the financial crisis had boom-bust characteristics with economic growth and a credit expansion followed by recession and a credit crunch. Banks play an important part in keeping the credit supply stable, but chapter 2 and 3 showed that they can contribute to quite the opposite. How does a volatile supply of credit affect the real economy?

During the financial crisis, banks experienced difficulties obtaining financing from investors in the market. The economic downturn had increased risk premiums for investors and financing became scarce and more expensive. This in turn, caused banks to rein in on their own lending to firms. To fund the lending growth in the periods prior to both crises, banks used an increasing amount of short-term financing, which deepened their problems once they were required to renew these loans during a credit crunch. How do the banks' financing problems in a credit crunch affect the composition of firms in the economy as well as the composition of their financing?

Banks have the ability to monitor investments, something that will be explained shortly, and can therefore grant loans to projects that are too small and risky to attract private investment. They are among other things the main suppliers of mortgages in Norway and because of this, the banks' lending activities are closely related to the evolution of property prices. Prior to both crises, the perceived risks and delinquency rates of mortgages were low. But as the business-cycle turned, risks and delinquencies increased. Does this imply that banks should ration credit, prioritizing applicants with a high credit-rating during economic booms to avoid increasing the risks apparently inherent to their segment of the lending market?

Technologies like the securitization taking place abroad and the creation of OMF in Norway gave private investors the opportunity to indirectly hold claims to loans they normally wouldn't, for example mortgages. The banks functioned as certifiers, using their information about the quality of mortgages turning them into collateral for financial securities. The funds acquired from selling such securities financed further lending growth. How can this process

affect the banks' share in financial markets and what happens to the system during an economic downturn?

The Basel Committee has stated that the capital levels in banks, both risk weighted and not, have been too low. The new regulation in development suggests that banks should exaggerate the actual credit risks during booms to safeguard against a recession. As a stabilizing improvement from the Norwegian banking crisis, Norwegian banks kept higher capital ratios prior to the financial crisis. What is a responsible level of bank capital and what are the implications of high capital requirements for the credit market and the real economy?

Like I described in chapter 3, the Norwegian government made several efforts to improve liquidity in the banking industry during the financial crisis. What are the problems associated with illiquidity, how do they relate to solvency problems, and could the banking industry take more precautions to avoid illiquidity without adversely affecting profitability?

Norwegian bankers had become far more experienced with operating in a competitive environment prior to the financial crisis, than they were in the wake of financial liberalization prior to the Norwegian banking crisis. How do manager's incentives and experience affect the investment risks taken by banks?

## 5 The model

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### 5.1 The microeconomics of banking

I will use a simplified view of banks consistent with that applied by the microeconomic models presented. When not mentioned otherwise explicitly, a bank will refer to a commercial bank or at least that fraction of a universal bank which focuses on traditional banking activities. Commercial banks are first and foremost treated as economic intermediaries with two important traits: The ability to transform short-term deposits into long-term loans, and the ability to cost effectively monitor investments. Further I will use the terms loans, assets and investments interchangeably, as opposite to deposits and equity, when referring the assets and liabilities sides of the bank's balance sheet respectively.

Banks operate differently from normal businesses. Instead of using inputs to maximize profits, a bank earns a return or interest on its loans and pays interest on its deposits. The profits made thus come from the wedge between these two interest rates times the size of total loans and deposits, minus various fixed costs. The bank is also required to keep a share of deposits as reserves to avoid illiquidity in face of, for example an unexpectedly high amount of deposit withdrawals. Reserve requirements can be kept in the interbank market which pays an interest rate, or in the central bank. At any given time, some banks have deficits while others have surpluses in excess of their need to meet their daily requirements. In order to keep banks liquid, the system necessitates a well functioning market for overnight and same-day settlement loans, where banks can quickly collect credit to complete transactions. Traditionally, the central bank met this need, but today an even larger amount of transactions occur directly between commercial banks, according to Demiralp et al. (2005). All lending activity between banks will, for the rest of this thesis, be referred to as lending in the interbank market, as opposed to lending to businesses or customers.

According to Holmström and Tirole (1997) the predictions of their model are broadly consistent with what happened during the Scandinavian banking crisis, in terms of the interaction between the financial and the real sectors. This view is shared by Allen and Gale (1999). It is an incentive model of financial intermediation in which both firms and intermediaries are credit constrained. The limited access to credit in the economy as well as the possibility of investment monitoring by intermediaries are the two main topics of interest when relating the model to the Norwegian banking crisis and the subprime financial crisis. Holmström and Tirole (1997), claim that firms are run by entrepreneurs who have limited

liability.<sup>13</sup> Because of this limited liability some firms may intentionally reduce their project's probability of success in order to enjoy a private benefit, that is if proper market incentives are absent and their activities are not monitored by an outsider. In the following section I will set up the important equations of the model and present some its technically important assumptions, as well as its further implications about bank behavior.

## 5.2 Assumptions and prerequisites

There are three types of agents in the model who are all risk neutral; namely firms, intermediaries and individual, uninformed investors. There are two points in time. At the first, investment decisions are made, and at the second, returns are realized (ibid). Firms have varying amounts of initial funds  $A$ , or collateral as the authors write, and are distributed along a cumulative distribution function  $G(A)$ . The aggregate amount of firm capital is  $K_f = \int A dG(A)$ . Each firm has an investment project  $I$  costing  $I > 0$ . If  $A < I$ , then the firm will require at least  $I - A$  in additional, external financing in order to undertake the investment in period 1. In period 2, the project can generate a verifiable return of  $R$ , in case of success, or zero, in case of failure. The success probability is denoted by  $p$ . The firm further chooses between a bad high-risk project with a high private benefit  $B$  should it succeed, and a relatively safe project with zero private benefit. The respective success probabilities of the two investment projects are  $p_L > 0$  and  $p_H > 0$  with the assumption that  $\Delta p = p_H - p_L > 0$ . To sum up:

$$\text{Good Project} = \begin{cases} R, \text{ with probability } p_H \in (0,1) \\ 0, \text{ with probability } (1 - p_H) \end{cases}$$

$$\text{Bad Project} = \begin{cases} R, \text{ with probability } p_L \in (0, p_H) \\ 0, \text{ with probability } (1 - p_L) \end{cases}$$

There is limited liability in the sense that a firm can lose only the value of its equity capital  $A$  in case of failure.

The opportunity cost of individual direct investment is  $\gamma$ , meaning that this is what such an investor could earn by placing his funds elsewhere in the financial market. According to Tirole (2006)  $\gamma$  can be either exogenously given, in which case the savings are completely elastic at interest rate  $(\gamma - 1)$ , or endogenously given by a standard upward sloping supply

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<sup>13</sup> Limited liability means here, that a borrower only can be held partly financially responsible, should his behavior cause him to default on his loan. We assume that all of the borrower's money has gone into the investment along with his loan, and that there is no other way for a bank to punish him directly ex post.

function  $S(\gamma)$ . For simplicity  $S(\gamma)$  will only be included in equilibrium conditions (9) and (10) in section 5.5. The analysis will treat  $\gamma$  as exogenous.

Only the good project is feasible from an economic view point:

$$(1) \quad p_H R - \gamma I > 0 > p_L R - \gamma I + B$$

But due to the limited liability of firms, their managers might still choose the bad project because of the private benefit  $B$ . We assume that a firm has to spend resources on managing its project, or at least has to exert a costly effort in some other way, in order to raise the project's success probability from  $p_L$  to  $p_H$ . This is desirable from an investors perspective, but by doing so, the firm will have to renounce  $B$ . From the firm's point of view, the best case scenario would be to shirk on the effort and having the project, which is then considered to be bad from the lender's standpoint, succeed anyway. The reduced effort cost by choosing the bad project is represented by the private benefit  $B$  whenever it is successful. Shirking is possible when investors are incapable of monitoring the firm's activities. Monitoring the firm reduces the private benefit from undertaking the bad project from  $B$  to  $b$ , where  $B > b > 0$ . The reason is that as long as certain activities are monitored, it will be impossible for the firm to completely avoid making an effort, without getting caught. Monitoring won't be able to reveal all inefficiencies however, and so the reduced private benefit  $b$  is still greater than zero. Even if almost all firm behavior were observable, an enforceable contract accounting for all foreseeable shortcomings would be too complicated, time consuming, and expensive to design in practice. Possibly very vague contractual breaches would also have to be proven to a third party. The expenses of attempting to reduce  $b$  to zero clearly outweigh the benefits. Monitoring a firm's activities also involves a cost and is only economically feasible for intermediaries in the market for indirect finance within this model. The uninformed investors in the economy find non-delegated monitoring to be too costly. The reason why banks, mutual funds and other such organizations are referred to as financial intermediaries, is because they collect funds from uninformed investors and use their expertise and share scale of operations to invest these funds efficiently. The economies of scale allow diversification of the investment portfolio. The concentration of skill, as well as repeated transactions with clients, enables the intermediary to cost effectively monitor investments. Individual investors do not possess the time or resources to monitor every investment on their own, and so they delegate this task to an intermediary.

The combination of asymmetric information in the credit market, limited liability of firms, and the cost of monitoring, creates a need for intermediary finance. The following sections will, by using the model by Holmström and Tirole (1997), describe firms' access to



direct finance, indirect finance and how the two types can co-exist in a credit market equilibrium due to hidden information, in that order.

### 5.3 Direct finance

This section presents a credit market without financial intermediaries. It is nonetheless important to include as its insights represent the foundations on which indirect finance can be introduced. Let's say that a firm invests  $A$  in its own project and uninformed investors invest  $I - A$ . Neither interested party is paid if the project fails, but in the event of success the firm gets  $R_f > 0$  and the uninformed investors get  $R_u > 0$ , where  $R = R_f + R_u$ . Since there is no private benefit involved for uninformed investors, besides their share of the realized project return, they would like the firm to always undertake the project with a high chance of success  $p_H$ . If the firm is to choose the good project, the following condition needs to hold:

$$(2) \quad p_H R_f \geq p_L R_f + B$$

In words, the firm's expected return from being diligent and choosing the good project, must be at least as large as the firm's expected return from choosing the bad project with the added private benefit  $B$ . This represents the proper market incentives mentioned earlier. A profit maximizing firm will always choose the bad project in the absence of monitoring by investors if this condition does not hold. We will return to that scenario in section 5.4 about indirect finance. Following from equation (2) and the fact that  $\Delta p = p_H - p_L$ , we get the incentive compatibility constraint for the firm: <sup>14</sup>

$$(ICC_f) \quad R_f \geq B/\Delta p$$

The previous condition, together with  $R = R_f + R_u$  implies that:

$$R_u = R - B/\Delta p \geq \gamma$$

The total return generated by a successful good project is  $R$ . This will have to be divided between the uninformed investor, whose share is  $R_u$  and the firm, getting  $R_f$ . If we assume that the firm's ICC holds,  $R_f$  must be at least equal to  $B/\Delta p$  for the firm to accept the investment contract and behave diligently. The share of return left for the uninformed investors  $R_u$  must

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<sup>14</sup>  $p_H R_f \geq p_L R_f + B \Leftrightarrow p_H R_f - p_L R_f \geq B \Leftrightarrow R_f(p_H - p_L) \geq B$   
 $\Leftrightarrow R_f(\Delta p) \geq B \Leftrightarrow R_f \geq B/\Delta p \text{ (ICC}_f\text{)}$

be at least as large as their opportunity cost  $\gamma$ . A necessary and sufficient condition for firms to obtain direct finance is:

$$(3) \quad \gamma[I - A] \leq p_H[R - (B/\Delta p)]$$

To explain (3) the sum to be invested in the firm's project  $I - A$  must yield an expected return at least as high, in absolute terms, as the opportunity cost of investing the money in the market  $\gamma[I - A]$  for the uninformed investor. Otherwise, the firm will not be able to attract any capital to its investment project. The expected return is just  $R_u = R - B/\Delta p$  multiplied by the probability of a good project succeeding  $p_H$ . We remember from before that only the good type project is economically feasible, and thus the only appealing business endeavor for uninformed investors. An interesting point is that the share of firm equity, relative to its project cost  $I - A$ , directly affects what return is required for a firm's investment project to acquire outside financing. Firms that are already well capitalized along the cumulative distribution function get easier access to outside funds. Capital attracts capital in this model. Drawing on all the above assumptions, we can define a minimum requirement for a firm's equity, for it to qualify for direct finance  $A \geq \bar{A}(\gamma)$ , where

$$(4) \quad \bar{A}(\gamma) = I - p_H/\gamma[R - (B/\Delta p)]$$

## 5.4 Indirect finance

Firms that fail to meet the capital requirements to qualify for direct finance may have the option to turn to a financial intermediary. As described above, investors want firms to deliver good projects. Intermediaries have the same preferences, but instead of leaving the firms' selection of projects to the existing market incentives, they can enforce the choice through monitoring. A firm that has chosen bad projects in the past might ruin its reputation and lose access to future financing, both direct and indirect. This line of reasoning relates to relationship banking and involves repeated transactions between lenders and borrowers.<sup>15</sup> Since the model by Holmström and Tirole (1997) is static and only considers two points in time I will not discuss this further here.

The intermediary in turn, gets a portion of its funds from uninformed investors. Hence the payoff of the project will be divided into three parts:  $R_f + R_u + R_m = R$  where  $R_m$  is the intermediary's share. This suggests that individual investors are worse off by delegating investment and monitoring to an intermediary, and thus involving a third party, than by

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<sup>15</sup> For a thorough description of relationship banking, see the article by Boot (1999).

investing in firms directly. This would also be the case, had it not been for the presence of asymmetric information. Intermediaries can exist within the model framework because some firms would choose bad projects deliberately in the absence of their monitoring. Investors are of course aware of this. One consequence of a credit market without financial intermediaries, but with asymmetric information, would therefore be a segment of firms, capable of undertaking good, profitable projects when monitored, not getting financed. The widely cited paper by Bhattacharya and Thakor (1993) notes that informational frictions generally, and proprietary and asymmetric information specifically, provide the most fundamental argument for the existence of financial intermediaries like banks.

By monitoring its borrowers, the intermediary can reduce the firm's private benefit from shirking from  $B$  to  $b$ . By inserting the reduced private benefit into the firm's incentive compatibility constraint, derived in section 5.3 concerning direct finance, we get the ICC for a borrowing firm subject to intermediary monitoring:

$$(ICC_f) \quad R_f \geq b/\Delta p$$

Another assumption required under indirect finance is that  $R_f < B/\Delta p$ , otherwise the firm would behave diligently even in the absence of monitoring. For unchanged relative success probabilities of the good and the bad project, we see that the return needed in order for a firm to find outside financing worthwhile has gone down. Monitoring comes at a fixed cost denoted  $c$  however. For the intermediary to find monitoring economically efficient, the following condition has to be satisfied:

$$(ICC_m) \quad R_m \geq c/\Delta p$$

This is the incentive compatibility constraint for the intermediary to actively monitor its investment. The return on informed investment must be at least as large as the cost of monitoring, divided by increased success probability of the project from  $p_L$  to  $p_H$  which monitoring ensures. The expected return for uninformed investors, from financing an investment through an intermediary, is then given by: <sup>16</sup>

$$(5) \quad p_H[R - (b + c/\Delta p)]$$

The expression (5) is simply what is left after both the bank and the firm have gotten their revenue shares of  $c/\Delta p$  and  $b/\Delta p$  respectively. Each of them must earn at least its opportunity cost to participate in the venture. The equation also assumes that delegated intermediary

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<sup>16</sup>  $p_H [R - R_f - R_m] \Leftrightarrow p_H [R - (b/\Delta p) + (c/\Delta p)] \Leftrightarrow p_H [R - (b + c/\Delta p)]$ .

monitoring, forces the firm to choose the economically feasible good project, hence the multiplication by  $p_H$ . Uninformed investors still have an opportunity cost of  $\gamma$ . If  $I_m$  is the capital invested in a project by the intermediary, the expected rate of return on intermediary capital is:

$$\beta = p_H R_m / I_m$$

Since monitoring is costly,  $\beta$  has to be greater than  $\gamma$ . This has the implication that firms prefer uninformed capital to intermediary capital. As mentioned earlier, a firm with a solid reputation and a significant own capital base can gather funds directly from the financial markets. The firms that fail to meet the required standards in terms of reputation and collateral have to turn to an intermediary for their capital needs, since uninformed investors find their projects too risky due to asymmetric information and limited liability. Some firms might not qualify even for indirect finance. This segmentation of the credit market is therefore not an optimal situation from the firms' point of view. In the real world, newcomers face a higher requirement for expected profitability than their more well-established counterparts which, through their longevity, are considered relatively safe investments in the credit market. The same goes for firms that are equity constrained. The intermediary's share of investment in a project is given by:

$$I_m(\beta) = p_H c / (\Delta p) \beta$$

Uninformed investors contribute  $I_u = I - A - I_m(\beta)$ . A necessary and sufficient condition for a firm to be financed is then:

$$\gamma[I - A - I_m(\beta)] \leq p_H[R - (b + c)/\Delta p]$$

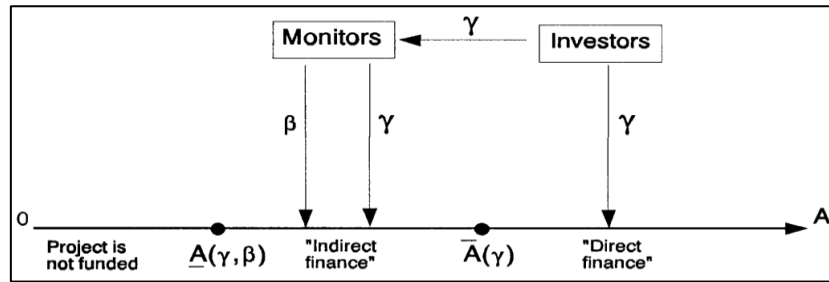
This can be rewritten as:

$$(6) \quad A \geq \underline{A}(\gamma, \beta) = I - I_m(\beta) - (p_H/\gamma)[R - (b + c)/\Delta p]$$

A firm with less initial assets than  $\underline{A}(\gamma, \beta)$  will not get financed by neither uninformed investors nor an intermediary.  $\underline{A}(\gamma, \beta)$  increases in both  $\beta$  and  $\gamma$ , so it gets more difficult to obtain financing when either the market rate of return  $\gamma$  or the monitoring rate of return  $\beta$  increases (Holmström and Tirole, 1997). The firms in this model can be divided into three categories: highly capitalized firms with  $A > \bar{A}(\gamma)$  which can fund their projects through direct uninformed finance, firms with  $\underline{A}(\gamma, \beta) < A < \bar{A}(\gamma)$  that can borrow funds from an intermediary, and finally there are the businesses with  $A < \underline{A}(\gamma, \beta)$  that fail to acquire any financing at all. Holmström and Tirole (1997) present two different figures to illustrate this

segmentation of firms in the credit market and the role of monitoring by intermediaries: Figure 2 shows the coexistence of uninformed and informed intermediary capital. The uninformed investors receive the same return from investing directly and indirectly in equilibrium. Otherwise it would be profitable to choose only the option with the highest return on investment.

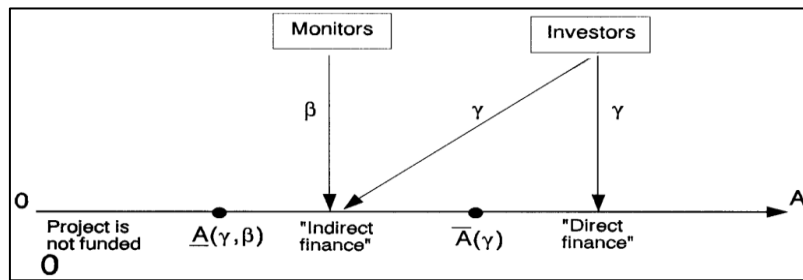
Figure 2: Financial intermediation.



Source: Holmström and Tirole (1997)

Figure 3 illustrates a second possibility where uninformed investors can use the monitoring of firms, by institutions like banks, as a certification mechanism. The market equilibrium is the same whether investors invest in  $\underline{A}(\gamma, \beta) < A < \bar{A}(\gamma)$  firms through an intermediary, or whether they use the intermediaries' interest in such firms as a signal to invest directly. This last possibility is what is meant by certification and can be related to the rapidly growing market for mortgage backed securities prior to the recent financial crisis. What matters to investors is that the monitor holds a sufficient stake in its firms (Holmström and Tirole, 1997). Later, I will show how securitization can both expand the use of certification and be a source for moral hazard.

Figure 3: Certification.



Source: Holmström and Tirole (1997)

### 5.5 Equilibrium in the credit market

The equilibrium condition for informed capital  $K_m$ , where  $D_m(\gamma, \beta)$  denotes the demand for informed capital, is:

$$(7) \quad K_m = D_m(\gamma, \beta) \text{ where } D_m(\gamma, \beta) = [G(\bar{A}(\gamma)) - G(\underline{A}(\gamma, \beta))]I_m(\beta)$$

The demand for informed capital is a function of the required expected rates of return on uninformed capital  $\gamma$  and informed capital  $\beta = p_H R_m / I_m$ . The demand for informed capital decreases in  $\beta$ , since a higher  $\beta$  means that such borrowing becomes relatively more expensive for firms. Those firms that barely managed to get access to indirect finance are squeezed out of the market. This can be seen directly from equation (8) as an increase in  $\beta$ , increases the minimum level of own equity required for firms to qualify for indirect finance  $\underline{A}(\gamma, \beta)$ . The effect of  $\gamma$  on the demand for informed capital is ambiguous, since an increase in this variable, increases both  $\underline{A}(\gamma, \beta)$  and  $\bar{A}(\gamma)$ , causing both indirect and direct financing to become more expensive, but possibly keeping the relative financing costs intact. The outcome depends on the distribution function  $G$ . The equilibrium condition for uninformed capital, where  $D_u(\gamma, \beta)$  denotes the demand for uninformed capital, is:

$$(8) \quad K_u = D_u(\gamma, \beta) \text{ where}$$

$$D_u(\gamma, \beta) = \int_{\underline{A}(\gamma, \beta)}^{\bar{A}(\gamma)} [I - A - I_m(\beta)] dG(A) + \int_{\bar{A}(\gamma)}^{\infty} [I - A] dG(A)$$

The  $I - A - I_m(\beta)$  is the remaining total uncovered project cost of firms qualifying for monitored financing only, after subtracting the value of their equity and contribution by intermediaries. The firms in this category are distributed according to  $G$  in the range  $\underline{A}(\gamma, \beta)$  to  $\bar{A}(\gamma)$ . The whole term  $\int_{\underline{A}(\gamma, \beta)}^{\bar{A}(\gamma)} [I - A - I_m(\beta)] dG(A)$  can then be interpreted as the aggregate demand for uninformed capital to be allocated to firms through financial intermediaries. This is seen more intuitively from Figure 2, where the arrows indicate how monitors finance this category of firms both through their own capital and by attracting additional capital from uninformed investors. The last term,  $\int_{\bar{A}(\gamma)}^{\infty} [I - A] dG(A)$ , is just the aggregate demand for direct finance by firms that don't need monitoring. The combined demand of these two segments of borrowers in the credit market gives the aggregate total demand for uninformed capital  $D_u(\gamma, \beta)$ . The market for uninformed capital clears when:

$$(9) \quad D_u(\gamma, \beta) = S(\gamma).$$

Holmström and Tirole (1997) show that for each  $\beta$ , there is a unique  $\gamma$  that solves equation (9).

The aggregate demand for capital, both informed and uninformed is given by: <sup>17</sup>

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<sup>17</sup> Using (9) with (7) and (8) we get  $\int_{\underline{A}(\gamma, \beta)}^{\infty} (I - A) dG(A) = \left\{ \int_{\underline{A}(\gamma, \beta)}^{\bar{A}(\gamma)} [I - A - I_m(\beta)] dG(A) \right\} + \left\{ \int_{\bar{A}(\gamma)}^{\infty} [I - A] dG(A) \right\} + \{ [G(\bar{A}(\gamma)) - G(\underline{A}(\gamma, \beta))] I_m(\beta) \} = D_u(\gamma, \beta) + D_m(\gamma, \beta).$

$$(10) \quad \int_{\underline{A}(\gamma, \beta)}^{\infty} (I - A) dG(A) = S(\gamma) + K_m$$

The left-hand side of equation (10) is aggregate demand for credit from firms that are above minimum requirement for equity and project return. The right-hand side is the supply of capital to these firms. In equilibrium, credit supply equals credit demand. The firms that are distributed below  $\underline{A}(\gamma, \beta)$  fall outside the market and are not funded.

## 5.6 Important results

The model by Holmström and Tirole (1997) shows how asymmetric information creates a genuine need in the market for financial intermediaries capable of monitoring investment projects when individual investors are uninformed. It also shows how banks may end up with assets that are individually more risky than those found in the market for direct finance, since the model expects them to finance firms relatively less well endowed in terms of reputation and capital. Such financial fragility and operational opacity will typically characterize small, young firms. As an empirical illustration of how firm size matters for their composition of external financing, consider, the table below on firms in US manufacturing. Firms are sorted from large to small and we clearly see the trend that small firms are prone to hold a much larger proportion of short-term bank debt than their large counterparts, 82.9 percent and 22.8 percent respectively. The row listing commercial papers' share of short-term debt shows that, predictably, large firms are the ones that first and foremost use emissions and direct financing as a source of funding. The share for large firms was 62.8 percent, whereas the share for medium sized firms only was 6.9 percent.

Table 1:

### Bank and non-bank sources of debt for American manufacturing corporations in 1991

Outside Financing	Total	Large	Medium	Small
<b>Bank debt/Total debt</b>				
Short-term	44.9%	22.8%	77.0%	82.9%
Long-term	31.2%	21.1%	51.7%	59.3%
Total	33.0%	21.3%	54.9%	65.5%
Commercial paper as % of short-term debt	N.A	62.8%	6.9%	N.A
Non-bank short-term debt	N.A	81.3%	30.1%	N.A

Source: Kashyap and Stein (1994).

From (7) we know that  $K_m = D_m(\gamma, \beta)$  and from (9) we know that  $D_u(\gamma, \beta) = S(\gamma)$ . Using

(7) and (9) to insert for the demand functions, we get  $\int_{\underline{A}(\gamma, \beta)}^{\infty} (I - A) dG(A) = S(\gamma) + K_m$ .

Simultaneously, banks must offer a satisfactory rate of return to obtain financing from uninformed investors. The combination of risky illiquid assets and the need for constant outside funding goes a long way to show how banks can be adversely affected by a credit crunch or a capital squeeze and how this in turn spills over to its borrowers. The key variables from the model that I will use in the analysis are; the demanded rates of return  $\gamma$  and  $\beta$ , the success probabilities for firm projects  $p_H$  and  $p_L$ , the lower limits to qualify for informed and uninformed capital  $\underline{A}$  and  $\bar{A}$  and the cost of monitoring  $c$ . Differences in these values will affect the composition of the credit market and a significant downturn in the economy is likely to influence all of them to some extent. The next chapter will make use of the insights provided by Holmström and Tirole (1997) to explain the various problems banks face when the economy turns from boom to bust. When the explanatory powers of the model are lacking, I will supplement it by different theories and experiences from the Norwegian banking crisis and the financial crisis.

## 5.7 Relevance for the Norwegian banking crisis

Holmström and Tirole (1997) focus on the US for empirical data when exploring the effects of a credit crunch, but their insights are relevant for describing the Norwegian banking crisis as well. In the US, the change in bank lending that occurred within states during 1990-1991 can to a large extent be explained by the 1989 capital-asset ratios of the banking sectors within individual states. Such a wide collection of data does not exist for the Norwegian banking crisis, since capital requirements for Norwegian banks were determined on a national level. When investigating how the banking systems of different states fared as the economy went into a recession, the data suggests that capital ratios did affect intermediary credit supply. In the Northeast of the country, there was a sharp decline in lending and this was also the area where real estate markets experienced the biggest drop. The positive correlation between these two phenomena demonstrates how banks are very vulnerable to reduced asset prices. From graphs 1 and 2 in chapter 2, we recall how the price evolution of Norwegian commercial real estate closely followed the development in bank lending. Holmström and Tirole (1997) also find evidence of a flight to capital in the credit market during the recession, which fits the models predictions that poorly capitalized firms will be squeezed out first in a credit crunch. Bernanke et al. (1996) write that borrowers who face considerable agency costs in the credit market are expected to be affected the most by an economic downturn. Such borrowers consist of small firms, consumers with little own capital or firms with weak balance sheets, all of whom are typically dependent on intermediary capital. The phenomenon that banks, when becoming



credit constrained, cut off their lending to such clients first is what is meant by a flight to quality and is similar to the intensified screening during recessions that I mentioned earlier and an increase in A. Borrowers with a relatively large share of own-capital invested in their own business ventures are more likely to make an extra effort to reduce the chance of project defaults. Firms that already find themselves in a weak position are thus, rather unsurprisingly, most adversely struck by fluctuations in the business cycle as their capital share falls below A. They are also the first to respond positively as the economy recovers.

The model by Holmström and Tirole (1997) makes several assumptions about the financial market. Firms with a sufficiently high net worth can use direct finance to fund investments. Those that don't qualify for direct finance have to lend from an intermediary capable of close monitoring, hence forcing diligent behavior. During the Norwegian banking crisis the segment of the property market that experienced the largest drop in prices was that of commercial property. Where the preceding credit boom had provided capital constrained firms with loans, the following crunch made it much harder for the same type of highly leveraged businesses to finance their investment projects. We remember how economic booms allow firms and consumers to borrow against the increasing value of their assets, and how these borrowers can become increasingly leveraged as asset prices fall. We also know that the reserve capital of Norwegian banks was at a low level throughout the lending boom, making them quite vulnerable to negative fluctuations in the business cycle. Since defaults are relatively less common as long as the economy is growing, the deregulation of the Norwegian financial markets caused banks to prioritize business expansion over asset quality. The fact that Holmström and Tirole (1997) treat not only firms, but also intermediaries as capital constrained in their model, is one important reason why I chose it to describe the Norwegian banking crisis as well as the latest financial crisis, as it seems like a crucial assumption for understanding bank behavior when the business cycle turns from boom to bust. Both banks and firms became overextended following financial deregulation, prior to the Norwegian banking crisis.

### **5.8 Applicability to the financial crisis**

According to Holmström and Tirole (1997), a strong growth in business loans increases the aggregate default risk of a bank's asset portfolio and results in less intense monitoring of investments. In 2006, as it is presented in a report from the Norwegian Financial Supervisory Agency, the interest rate margins charged by banks prior to the financial crisis were small (Finanstilsynet, 2006). A significant, industry wide increase in the volume of loans and

deposits contributed to high earnings for the banking industry. The prevailing, favorable macro situation, made loan losses were very manageable and outside debt financing was easily available to banks. Since both asset risks and funding liquidity problems were small, the banks were able to operate small levels of capital. These general facts about the Norwegian banking industry prior to the financial crisis are largely consistent with the theoretical assumptions of the model and the experiences prior to the Norwegian banking crisis. It should be mentioned that banks investments were generally safer than in the late 1980s, and that bank managers had gained much experience from operating in a competitive environment since then. Competition however, forces down the market interest rate margins, causing banks to increase the volume of loans and deposits relative to capital to maximize profits. While the general economy was doing well and few loans defaulted, it was difficult for regulators following Basel II to efficiently reduce the potential future riskiness of the banks' portfolios through counter-cyclical measures and capital requirements were kept at a low level.

An overextended banking system can quickly become very illiquid when exogenous shocks cause an economic recession. When asset prices deteriorate, the resulting credit crunch can affect the whole economy as small businesses dependent upon intermediary capital are getting squeezed, unable to find other sources of funding for their projects. Like I mentioned in chapter 3, these problems were much smaller for Norwegian banks than for example for US banks, and also significantly smaller than during the previous crisis. Illiquidity however, did become a serious problem as the credit market dried up.

As the model by Holmström and Tirole (1997) predicts, as the economy was recovering from the recent financial crisis and banks were experiencing difficulties with renewing outside financing, they were forced to reduce their own lending to firms. The crisis also affected the profitability of borrowing firms, squeezing their capital and thus making them more risky from the banks' point of view. Due to the credit crunch and capital squeeze banks became reluctant to lend both to more risky businesses as well as to each other, easily seen by the prevailing high rate of interest on interbank loans after the financial crisis struck.

## 6 Analysis

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### 6.1 The fragility of banking

The fragility of banking provides a basic theoretical starting point for describing the relation between the Norwegian banking crisis and the recent financial crisis. Before discussing the model by Holmström and Tirole (1997) directly in relation to more specific topics, I would therefore like to dedicate a paragraph to this fundamental basis for understanding how the banking industry is exposed to risk and fluctuations in the business cycle.

When market conditions are favorable and few loans default, banks would want to keep as small capital reserves as possible, relative to the size of their balance sheets. Any unused capital is a restriction on the investment strategy. The essence of profitable banking is to collect as much capital as possible through deposits and then to invest the money as efficiently as possible through lending, while keeping the interest-rate spread high. The fragility of banking comes from the fact that deposits are considered very liquid while loans are quite illiquid. If the percentage of deposits kept as reserves is small, the bank may have to terminate investments prematurely to pay off depositors, in the event that some of them may want to withdraw a considerable amount of money for some reason, rational or arbitrary. A bank run, being a rather extreme manifestation of this scenario, can be based on either; rational expectations about a bank's insolvency or less fortunately, on self fulfilling speculation. The bank is likely to lose money by selling off investment projects prematurely, often at what is called fire sale prices. If the total resale value of loans is less than the required price of compensating depositors, the bank is insolvent and goes bankrupt. Although bank runs happen very rarely nowadays, it may still be the case that the deterioration of a bank's assets leaves it momentarily illiquid and in urgent need of means to complete market transactions. Capital reserves work as a buffer against illiquidity and finally insolvency if many loans should default, or in the less common event of an arbitrary bank run. To summarize, capital requirements force banks to choose sub-optimal investment strategies in a boom, but may secure them against insolvency in a recession. As in the example of credit rationing, the important trade off is low risk and stability versus the possibility of high profits.

There are two ways a bank can increase its profits within the simple framework presented in the model by Holmström and Tirole (1997), when treating the fixed costs as exogenous. It can either increase the difference between interest rates on loans and deposits, or it can gear up its balance sheet, that is increase the amount of loans and deposits relative to the size of its own capital. Since the banking sector is assumed to be competitive in the model, the

interest rates are also exogenously determined in the market for credit supply and demand. This leaves only the latter option, which leads us to an important point, the fragility of banking. If a competitive bank faces no regulation, it will want to reduce its reserve capital to zero. This is money that cannot be invested in the market for bank loans and therefore forces the bank to choose a less than optimal level of market exposure. The reserve capital has an important function however. Whereas bank deposits are very liquid and can be withdrawn at almost any time, loans are usually long-term and quite illiquid, which is an intrinsic risk factor in the banking system. The capital reserves create a buffer of liquidity beyond what can be lent in the interbank market, should a bank be in a liquidity crisis, for example due to many unexpected simultaneous withdrawals or a decline in loan repayments. Basically, the share of a bank's capital that is not invested in illiquid assets diminishes earnings when the bank is doing well, but works as a safety net during bad times. When a recession puts the whole banking system under strain due to reduced returns on assets, the ability to still pay off depositors preserves the individual banks reputation for being safe. In rather extreme cases, the rumor of a bank being illiquid can cause a panic among its depositors, eventually resulting in a bank run. This, famously, happened to Northern Rock during the recent financial crisis.<sup>18</sup> The desire for banks to minimize capital buffers to enhance efficiency is an important part of the model, when using it to illustrate how the banking system is affected by a recession. As Holmström and Tirole (1997) write, the Scandinavian recession, including the Norwegian banking crisis, arguably started as a credit crunch, since banks were overextended and had to reduce their lending. When the aggregate share of capital in the banking industry is low, interbank credit is quickly depleted, so there is a relatively high risk of individual bank illiquidity becoming systemic.

## 6.2 The availability of credit and consequences for small firms

A proposition made by Holmström and Tirole (1997) is that a reduction in the supply of capital, due to some macroeconomic shock, reduces aggregate investment and increases the lower limit on equity capital required for a firm to qualify for indirect financing,  $\underline{A}(\gamma, \beta)$ . The result is that poorly capitalized firms are the first to lose their financing during a capital squeeze or a credit crunch. A firm with a strong capital base can always do as well as a firm with fewer internal funds as long as a reduction in firm or intermediary capital is not offset by an increase in uninformed capital. The possibility that uninformed investors would step in to save a firm that has just lost its informed financing, hence gaining a less favorable reputation, seems unlikely. This insight has important implications for allowing financial intermediaries to

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<sup>18</sup> For a detailed description of that particular incident, see Shin (2009).

be poorly capitalized during booms, since it increases the volatility of credit availability in the economy.

During the recent financial crisis, bank lending both to firms and in the interbank market dried up. Banks that operated on small capital buffers were severely affected by the credit crunch. In a recession it can be assumed that the rates of return on investment projects  $R$ , as well as the probability of success for a good project  $p_H$ , are going to decrease. The reduced success probability implies increased asset risk for the lending party. Following the logic of Holmström and Tirole (1997), a reduction in these two variables causes  $\underline{A}(\gamma, \beta)$  to increase, meaning that borrowers require higher levels of equity capital and expected project profitability to qualify for any sort of outside financing. Capital poor firms are necessarily bound to be squeezed out of the market first. Since the model predicts that small, young and opaque firms are the ones most adversely affected by a credit crunch, a pro-cyclical bank lending pattern will contribute to make the operation of such businesses more uncertain. Relative to their larger, more well-established counterparts, a higher share of small scale firms might therefore also go bankrupt during a recession, since their financial situation is in danger of being weakened from two sides. Firstly, like most firms in a recession they are faced with a reduced demand for their products and services, but second and maybe equally important, is the possibility that their access to outside lending might be cut off as well.

Although stock prices also fall during a recession eroding the capital of firms using direct financing, this implies that the opportunity cost of direct investment  $\gamma$  has decreased. As long as the performance of an individual stock coincides with the market index, investors are not more likely to sell the stock of any particular firm unless. A serious firm specific capital flight generally requires sub-par performance or widespread speculation about future bankruptcy. The effects of a recession on a directly financed firm with a solid reputation will therefore be less dramatic than for a small and opaque firm since its funding, although diminished, is unlikely to be cut off completely. The ability to diversify financing sources is important for operational stability. Small firms are interestingly also the first to recover when the recession ends, but only if they don't go out of business first. Bankruptcies represent a real irreversible cost to the economy and the real value of stability in the banking system and the credit market therefore becomes evident. Pro-cyclical banking is economically inefficient for society in the long run, since it causes the share of small-firm bankruptcies to increase during a recession. The economic costs incurred by allowing a highly leveraged banking industry therefore outweigh the gains from increased profits during booms, due to bankruptcies.

Holmström and Tirole (1997) fail to mention the social cost of bankruptcies when explaining the squeezing of firms. Neither do they include the possibility of bank failures in their model.

### 6.3 Bank failures

The failure of large financial intermediaries like Lehman Brothers, Bear Stearns and AIG were a crucial part of the US experience during the financial crisis and the situation would have been much worse had the government not intervened by injecting new funds. From chapter 2 we also remember how the stocks of major Norwegian banks were written down to zero during the Norwegian banking crisis.

An externality arising from bank failures is that the clients of a failed bank are disconnected from future funding. Borrowers of quality  $\underline{A}(\gamma, \beta) < A < \bar{A}(\gamma)$  often depend on financing from a single bank. Although they have the opportunity to move their custom to a surviving bank, this bank will have less direct information about them. The banking industry is characterized by long-term customer relationships during which time valuable information is gathered through monitoring and repeated transactions. When an intermediary is liquidated, valuable private information about its borrowers is likely to be lost. In a stressed market situation, when major bank failures usually occur, the terms of replacing a credit-supply arrangement for disconnected firms are likely to be particularly tough, since asset risks are perceived to be high and banks are reluctant to accept new and potentially risky customers (Brunnermeier et al, 2009). Holmström and Tirole's (1997) theory predicts that banks with liquidity problems are eager to obtain safe investments, and might want to steer away from small and opaque investment projects. This assumption is backed up by Norwegian banks' reaction to the recent credit crunch as they reined in on their lending to new customers (Norges Bank, 2009).

Within the framework of the model, a bank becoming insolvent can be seen as an extreme case of a credit crunch for its borrowers. The interesting difference from an aggregate credit crunch without bank failures is that not only will firms with an equity capital slightly above  $\underline{A}(\gamma, \beta)$  temporarily lose their access to intermediary finance. In addition, a whole range of borrowers, in terms of quality, will enter the market competing for access to a new source of funding. Due to lost private information, the market for intermediary finance will fail to absorb all economically efficient investment projects, when firms seek a credit source replacement in the wake of a bank failure. A further analysis of whether the level of own capital that under normal market conditions would provide a firm with intermediary finance is still sufficient after a bank failure, could be an interesting addition to Holmström and Tirole's

(1997) model. At least we know that the Norwegian government has bailed out important banks in the past and is likely to do so in the future, exactly because of the distresses associated with a large bank failure, not to mention the risk of contagion.

## 6.4 Liquidity

When a bank experiences liquidity problems, the market will usually start to speculate about its underlying solvency as well, despite efforts made by the bank to deny this. An illiquid bank that has yet to fail, will often be required to sell off assets at fire-sale prices in order to rid itself of the illiquidity problems. A consequence of such fire sales is that the market prices of similar asset will be driven down when these are valued on a mark-to-market basis (Brunnermeier et al, 2009).

Mark-to-market valuation is used to measure the current price of an asset.<sup>19</sup> The price is often based on the market's valuation of similar assets. An example showing the usefulness of mark-to-market valuation is the sale of an apartment in which the seller has lived for, say ten years. Prior to such a sale it will be important to determine the present value of the apartment as its old nominal price is outdated and inaccurate. A natural starting point would be to base its value on the recent going prices of other apartments of similar quality (size, location etc.). If housing prices are generally low at the time due to an unfavorable market situation, this is likely to be bad news for the seller. If he still has a mortgage, the reduced asset price means that his capital share has decreased. Similarly, a major fire sale is likely to hurt the financial situation of other banks since it causes the value of their assets to be reduced, forcing them to sell assets of their own to improve their liquidity situation and capital ratios. During the recent financial crisis, the mark-to-market values of banks' assets did not only fall, but were also in many cases difficult to determine, resulting in increased speculation and perceived asset risks. When there is a widespread liquidity problem in the banking industry, attempts at alleviation may thus create solvency problems, even if there initially were none. Solvency and liquidity are not exogenous to one another (ibid). When problems in the banking system are systemic, the result of illiquidity and fire sales can be a downward spiral capable of causing solvency problems for banks and other financial intermediaries as their balance sheets are negatively affected. Fire sales devalue assets, which causes more illiquidity and further fire sales (ibid).

To safeguard banks against liquidity problems, they are imposed to keep reserve requirements, but such an arrangement does not come without certain unfortunate consequences relating to asset risk. If reserve requirements are to increase, this means that the

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<sup>19</sup> Definition of Mark-to-market (MTM) from: <http://www.investopedia.com/terms/m/marktomarket.asp>

invested share of funding provided to intermediaries decreases. In the model, all depositors are investors who demand a return of at least their opportunity cost  $\gamma$  and the model therefore predicts that for all other things equal, the return on the remaining intermediary investments would have to increase on average to satisfy investors. Drawing on the basic correlation between return and risk in finance, this means that a bank with a high reserve requirement would have to increase its asset risks to compete for private investment (Lintner, 1965). Prior to the financial crisis, US banks boosted their profits through securitization and gearing technologies. This is an interesting notion since reserve requirements of banks are kept to compensate for risk of illiquidity, while market incentives might cause them to have the opposite effect. To prevent banks from having a too risky asset portfolio as a compensation for reserve requirements, capital requirements tied to asset risk are also needed.

## 6.5 Credit rationing and capital requirements

I started chapter 2 by writing about how the Norwegian banking industry was subject to a government forced rationing of credit prior to the financial deregulation of the mid 80s.

Consequently the banking industry faced very little risk during that time and fluctuations in credit supply were small. As a result, capital requirements were low, according to Steigum (2004), which in itself is efficient from a banks point of view. If the banks can successfully screen customers, then they will capture the best ones.

According to Stiglitz and Weiss (1981), an equilibrium with credit rationing in the market for bank loans means each bank will hold a less risky loan portfolio than in an equilibrium without credit rationing. The argument is as follows: Suppose that the total demand for bank credit in the economy consists of individual agents with different risk profiles for their investment projects. If a bank were to lend money to just one borrower, it would naturally choose the agent with the least risky project (i.e. the smallest chance of default) willing to accept the offer at a given rate of interest. Hence, by providing credit to this particular agent, the bank would be maximizing its expected profits. As the bank lends money to more borrowers of a gradually declining quality, the risk of default for each new loan increases and the bank would have to be compensated through a higher interest rate. Let's say, for simplicity, that the bank has to offer the same rate of interest to all its clients. An increase in the offered rate means that some low-risk clients might decline a loan, hence increasing the level of default risk for the remaining pool of borrowers. The preferred rate is therefore the one that for a further marginal increase would cause the bank's expected profits to decrease due to



increased default risk. The result could be an equilibrium with credit rationing, even without demand for credit being naturally in excess (Stiglitz and Weiss, 1981).

During both the Norwegian banking crisis and the financial crisis, capital constrained banks reined in on their lending, to avoid further exposure to mounting market risks. As an alternative to using fire sales, banks under stress can ration credit via higher interest rates or margins/ haircuts to regain liquidity and improve capital ratios. Such deleveraging implies a cost to the banks' borrowers (Brunnermeier et al, 2009). Haircuts increased during the financial crisis and rather dramatically for some assets. For ABSs, haircuts went from 3-5 percent in April 2007 to 50-60 percent in August 2008 (IMF, 2008). As borrowers become credit constrained or face tougher terms on their loans, their default risks increase. The increased default risks mean that the bank's assets have become more risky, causing banks to further rein in on their lending. It is, in other words, possible to enter a self-amplifying spiral where credit restrictions tighten and the economy is weakened, both developments feeding back into one another (ibid.)

In the model by Holmström and Tirole (1997) credit rationing, forced or not, creates a barrier to private enterprise, artificially driving up  $\underline{A}$  and is therefore not an efficient arrangement. Rationing can either be done by reducing the size of a bank's lending operation or by making borrowing prohibitively expensive through increased interest rates, equivalent of increasing  $\beta$ . Either way, the number of successfully financed projects will be reduced. Uninformed investors are unwilling to replace bank lending due to asymmetric information.

Allowing high credit levels during booms cause strong fluctuations in credit supply, amplifying the oscillation of the business cycle. Arguably, these fluctuations constitute a larger cost to the economy than having a suboptimal level of credit during booms in order to achieve overall stability in credit levels and hence, the business cycle. This is generally a result of marginally positive, but diminishing returns to a credit expansion. Negative deviations from trend credit supply has a larger impact on the economy than positive deviations of similar magnitude. Perhaps more importantly a volatile credit supply increases bankruptcy risks for firms and other financial intermediaries during recessions. A solution would therefore be one of self-imposed credit rationing. By this, I mean a system where banks account for the true risks of lending irrespective of the prevailing market situation and are able to successfully sort the good risks from the bad when the economy is booming, as opposed to a regulated ceiling on credit expansion. Such a system of prudence would imply that a segment of firms that get loans under the current system, during a favorable market situation would lose their access to credit. On the upside, prudent lending would contribute to limiting loan losses for banks and

the extent of a credit crunch during a recession, when stressed banks ration through increased margins and interest rates.

The Basel Committee took a step in the right direction in this respect, when it is suggested that banks should treat asset risks during booms as if the market was growing at an average pace. Such regulation would reduce the impact of bubbles and subsequent corrections on credit supply. The inspiration for this suggestion came from the Spanish banking system where capital buffers had been successfully built up prior to the financial crisis (Norges Bank, 2009). The main goal of capital buffers is to induce counter-cyclical behavior that contributes to making banks and credit supply less responsive to fluctuations in market risk. Some additional firms will, like I mentioned be denied bank financing during booms, so for such an arrangement to be as efficient as possible, i.e. allocating credit to the best borrowers, banks will have to invest sufficiently in monitoring and screening technologies.

## 6.6 Banks' approach to monitoring

Compared to venture capitalists, commercial banks do not monitor their projects as intensively. Venture capitalists spend far more time and effort overseeing the project management's activities. Since they are more deeply involved than banks in controlling the outcomes of the projects they finance, they also hold a much larger stake in them (Holmström and Tirole, 1997). Banks on the other hand are able to extensively leverage their capital, partly because of their comparably lower cost of monitoring. There is a trade off in the sense that, an intensification of project monitoring to enhance the individual project's probability of success, means that there will be fewer resources available to spend on other investments, hence diminishing profits stemming from gearing and diversification. During economic booms, default risks are low ( $p_H$  and  $p_L$  increase) and rigorous monitoring is less profitable and might be scaled down. An example is how Norwegian banks went from on-site inspections to document based monitoring prior to the Norwegian banking crisis (Vale, 2004).

In the model, bank monitoring is only represented by a fixed cost  $c$  that does not depend on the size or complexity of the investment project being monitored. This feature grants obvious returns to scale from monitoring when the intermediary chooses an investment project and only contributes further to the squeezing of small firms, particularly during a recession. When experiencing a credit crunch, banks will be extra careful in their selection of loan applicants and Holmström and Tirole (1997) write that in this situation banks make an extra effort sorting out the good risks from the bad. Conversely,  $c$  is likely to be reduced during a boom, since the risk of failure for both good and bad firm projects are expected to be small

and it might be difficult separating the two without sufficient monitoring (i.e. it will be easier for a firm with a bad project to successfully present itself as a firm with a good project). The consequence of increasing  $c$  within the model framework is that intermediary financing becomes relatively more expensive, requiring a higher return to break even,  $R_m \geq c/\Delta p$  increases. This means that the share of intermediary finance in the economy is reduced relative to the share of direct finance. If monitoring intensity increases, *ceteris paribus* increasing  $c$ , we can also assume that the private benefit from shirking  $b$ , decreases and so the effect on  $p_H [R - (b + c/\Delta p)]$  is ambiguous. From empirical experience an intensification of monitoring is likely to make credit supply less volatile in response to fluctuations in the business cycle. Dampening an expansion of credit during booms and limiting a contraction during recession as long as intermediary finance is replaced by direct finance. Since the opportunity cost of investors is exogenously given, the model predicts that this is unlikely to happen.

The model of Holmström and Tirole (1997) also predicts that, as informed capital gets scarcer, i.e. less well capitalized financial intermediaries, the result is a shift towards less intense monitoring, and vice versa. So even though banks screen loan applicants more thoroughly during a credit crunch in an attempt to capture the best clients, the tendency is to spend less money on monitoring once a loan is granted. The only basis for efficient screening in the model by Holmström and Tirole (1997) is the level of own capital in firms. If screening cost were included with the monitoring cost  $c$  it is less intuitive how a bank's total expenditures to such activities are affected by market conditions. It is also possible to imagine that the economy can end up in one of two separate equilibria, one with intensive monitoring and another with lax monitoring, depending on the number of firms in the financial markets profiting from such activity.

## 6.7 Model shortcomings

The model describes both intermediaries and firms as credit constrained, but does not go into any depth when describing intermediary financing options. Intermediaries are assumed to only possess a share of the capital necessary to finance projects and collect the rest from uninformed investors. There is no distinction between depositors, debtholders and shareholders, and as a result banks are not subject to any capital requirements. Based on the presentations of the two crises in chapter 2 and chapter 3, well designed capital requirements can play an instrumental part in reducing credit fluctuations. Strong capitalization of an intermediary will reduce the upward pressure for return on investment  $\gamma$  by investors, since debt financing constitutes a

smaller share of the banks funding. A bank with a high capital ratio will *ceteris paribus* be able to focus on a less risky, relatively long term investment strategy compared to its highly leveraged competitors.

Furthermore, funding liquidity risk stems from the maturity mismatch between assets and liabilities (Brunnermeier et al, 2009). By acquiring a large share of long term funding, a bank improves its ability to provide a stable supply of credit to its borrowers by reducing the maturity mismatch. During the financial crisis, Norwegian banks, despite holding relatively safe assets, experienced liquidity problems as they had to refinance short-term debt under difficult circumstances, the consequence of which was reduced lending activity. By simplifying intermediary funding in the model, an important source of financial instability in a credit crunch is lost. The likely result is an underestimation of the impact that a credit crunch can have on the system.

Holmström and Tirole (1997) further claim that their model makes an argument for procyclical capital-adequacy ratios in a recession. Market incentives would make it desirable for intermediaries to reduce their capital during recession due to higher interest rates. The introduction of regulated capital adequacy ratios changes this conclusion. Basel I had been in place for some years by 1997 and it seems only reasonable to include its importance on the model's conclusions regarding intermediary capital level evolutions. What the banks are allowed to do within this framework is to reduce their capital buffers, while capital adequacy ratios may in fact increase. If buffers are already low when recession strikes, regulation may require banks to increase their capital during a recession. We know that intermediary credit supply  $K_m$  increases in  $\beta$ . The success probabilities of firms' projects  $p_H$  and  $p_L$  can be expected to increase during booms, causing asset risks to decrease and  $\beta = (p_H R_m)/I_m$  to increase. Since capital regulations tie capital adequacy ratios to asset risks, intermediaries have the freedom to invest more in this situation when capital requirements are low. At a time when asset risks are low, banks have the incentive to reduce their buffers as well, knowing that they can legally operate on their minimum requirement while increasing their profits as much as possible through leveraging. The lending growth prior to the two crises in question was largely financed by short-term debt and banks were operating on a low share of easily down-writable capital. As boom turned to bust, the perceived asset risks increased, interpreted in the model as a decrease in  $p_H$  and  $p_L$ . Capital regulations then impose banks to increase their capital ratios to compensate for the increased asset risks, instead of reducing them in response to increased interest rates. Although Holmström and Tirole (1997) look at an unregulated market which is

interesting in itself, the inclusion of a simplified version of capital regulations would benefit their model when using it to describe a financial crisis.

Another problem originates from the model's treatment of asset risks itself. As opposed to a relatively small independent investor a bank has the necessary amount of capital to diversify its portfolio of assets. If its investments are only weakly correlated, then we know from basic financial theory that the total risk of the portfolio is reduced by diminishing the idiosyncratic risk component. Lintner (1965) writes that the appropriate measure of risk for an individual asset within a portfolio of risky assets is not only provided by its return-variance, but also its covariance with the other securities in the portfolio. Holmström and Tirole (1997) make the somewhat extreme assumption of perfect correlation in financial markets, hence removing the benefits of diversification. This somewhat diminishes the economies of scale available to a large financial institution. The assumption becomes somewhat less problematic when describing a recession. While perfect correlation is particularly unrealistic under normal market conditions, the two crises discussed in this thesis were preceded by exogenous shocks to the economy causing the prices of weakly correlated assets to deteriorate simultaneously, making the impact of the simplifying assumption less severe. A good example is the way mortgages from different American states were pooled together as collateral for financial securities prior to the subprime crisis, in an attempt to diversify away the delinquency risk and default risk of each individual mortgage. Even though this obviously provided security against fluctuations in local markets, it failed to withstand a widespread downturn in the national housing market. Treating assets as perfectly correlated is still unrealistic since some asset prices always shift more than others, but less so when an entire market or even the economy as a whole starts slowing down.

Holmström and Tirole (1997) fail to mention the self-amplifying processes caused by deleveraging that can affect the banking industry during a recession. I mentioned in sections 6.4 and 6.5 how downward spirals are caused by both bank's credit rationing through increased margins and interest rates and banks trying to alleviate liquidity problems through asset sales. This is an important criticism of their model since the possibility of such downward spirals increases the severity of both a credit crunch and a capital squeeze, which the authors expect to occur during a recession like the Norwegian Banking crisis. Nonetheless, banks will have to deleverage during a recession to reduce asset risks. If they do not, they are likely to be punished by the stock market and investors. Solidity is an important prerequisite for a bank to obtain outside financing and the decision to deleverage is thus rational from the individual bank's point of view, even if it is harmful to the system as a whole (Brunnermeier et al, 2009).

When using the model to describe a crisis, a nice addition would be some mention of the mortgage market. Banks are the primary lending institutions for mortgages, and as was seen from both, the Norwegian banking crisis and the financial crisis, the economic downturns were closely tied to bubbles in property markets. This could easily be included, since one of the main factors determining whether a mortgage is granted or not, is the borrower's own capital. During the strong growth in property prices prior to both crises,  $\underline{A}(\gamma, \beta)$  went down, causing in some cases unqualified applicants to get a mortgage. This is not so much a criticism of the model's general conclusions, but merely an argument for the role being played by property prices in relation to both crises, as opposed to risky projects, deserving to be highlighted.

## 7 Theoretical extensions

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### 7.1 Securitization

We remember from section 6.1 how a bank that is short of liquid assets, may have to satisfy depositors' demand by liquidating investments before their full return is realized at low prices, also known as fire sale prices. If instead the bank could negotiate an asset price with an interested third party in advance, illiquidity would not entail the loss associated with premature liquidation. Securitization allows a bank to do exactly that. In addition to dealing with the liquidity risk inherent in the banking system, securitization also allows banks to pass the default risk of a loan on to a third party through an SPV. Banks have the opportunity to monitor their assets closely and can therefore obtain relatively more information about their true value and risk than international investors at efficient cost. In other words, there exists an information advantage to be exploited. Since the size of the capital requirements depends on the risk profile of the bank's loan portfolio, securitization allowed banks to gear up their balance sheets, increasing the volume of loans and deposits relative to their own capital.

Diamond and Rajan (2009) write that it is very problematic for an international investor, being geographically removed and thus possessing limited local knowledge, to hold a home mortgage loan directly. A mortgage loan requires servicing and is characterized by being of an uncertain credit quality, as well as having a higher propensity to default than an arm's-length conservative investor feels comfortable with. Securitization was able to alleviate some of these concerns. If mortgages from different areas were packaged together, diversification would reduce the risk. Under normal market conditions the individual mortgage qualities would only be weakly correlated. If the national economy is not hit by a macroeconomic shock, then a borrower defaulting on his mortgage in Los Angeles should not affect the default risk a mortgage located in New York, or the overall risk of a well diversified portfolio of mortgages for that matter. Individual risks can be diversified away, whereas systematic risks affecting the whole housing market is something investors cannot get rid of.<sup>20</sup> In a seemingly healthy, growing economy this was a seemingly small concern however. Furthermore, the securities derived from a package of mortgages were organized into different risk categories with matching ratings the way I described above. The riskiest claims against the package could be sold to those with the capacity to evaluate them and an appetite for risk, while the safest AAA-rated claims could be held by international investors. In fact, because of the high demand from international investors for AAA-rated products, securitization became focused on creating

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<sup>20</sup> For a financial theory regarding portfolio optimization, diversification and systematic risk, see Lintner (1965) for an accessible explanation.

as much AAA paper from an underlying package of mortgages as possible. Ironically, one type of financial institution with a penchant for evaluating mortgages is a bank. Hence, because of this and their relatively new born venture into investment banking activities, banks ended up holding many of the riskiest, and ultimately worst, claims themselves.

Holding AAA paper is no guarantee against systemic risk, despite the existence of capital adequacy ratios tied to a bank's asset risks under Basel I and II. Brunnermeier et al. (2009) argue that a similar drop in the rating of a bank's assets will have larger consequences for a bank initially holding primarily AAA securities, than one which holds BBB securities if both banks operate with an equal capital buffer above their respective capital adequacy requirements. In other words, marginal changes in ratings and risk is what matters. The authors give three reasons for this. First, AAA assets are systemic to a larger extent because they are the most likely to lose value in an unexpected system-wide crisis. Prior to the recent financial crisis, we remember how the division of CDOs into tranches allowed large quantities of AAA mortgage-backed securities to be issued. Since these were ultimately linked to the housing market, the senior tranches were considered safe while housing prices were increasing on aggregate, but their ratings were reduced simultaneously as the bubble burst and the equity and mezzanine tranches originally designed to carry the idiosyncratic risks became insufficient buffers against losses. BBB assets, on the other hand, incorporate idiosyncratic risk and the market expects them to be less safe, recession or not, and so possible value losses are accounted for through relatively high capital requirements for the owner of such assets also during booms. Second, the reduction in market-to-mark value can be greater for AAA paper in a recession and finally, the pressure for increases in capital requirements as asset ratings drop will be greater for a bank holding AAA assets. This is because the marginal capital adequacy ratio is positive, but diminishing in asset risk (Brunnermeier et al, 2009).

## 7.2 Certification

To include securitization into the model by Holmström and Tirole (1997) directly is difficult, but, we remember from section 5.4 how it accounts for the fact that uninformed investors will eventually also take an interest in firms funded by intermediary capital. When such a firm has shown that it is capable of maintaining a business relationship with an intermediary, carefully monitoring its projects, it sends a positive signal to uninformed investors. A financial intermediary has then become a certifier for its assets. Unless they expect the company's behavior to change radically once the composition of its funding changes, they may find it worthwhile to contribute with uninformed capital. In an article from 1991 Diamond finds



exactly this. If moral hazard is widespread among borrowers in the credit market, then new firms have to earn a reputation for being responsible before they gain access to direct financing options. This can be achieved by initially submitting themselves to monitoring by an intermediary. As a firm gains a favorable track record from repeatedly choosing good projects its credit rating will eventually increase. Such signaling reduces the problems associated with adverse selection for uninformed investors. Intermediaries such as traditional banks, with cost efficient monitoring capabilities can, in other words, pave the way for less risky uninformed direct investment in terms of the signal it sends to the financial markets, by continuing the relationship with a borrower or not.

The perpetually existing pool of borrowers that are dependent on intermediary finance consists of firms with a mediocre credit rating. The rating is too low for reputation effects to eliminate moral hazard alone, but is high enough, so that the moral hazard can be eliminated through efficient monitoring. In other words, only intermediaries capable of monitoring will invest in such relatively high-risk, low-rated firms. Holmström and Tirole (1997) touch on this point in their article, but since their model itself is static, it cannot incorporate the reputational effects achieved through repeated transactions in its mathematical setup.

When banks originate secured loans and provide loan guarantees, and this ability increases the importance of diligent bank monitoring in relation to the recent financial crisis. For this system to work however, it requires that intermediaries are actually efficiently monitoring all of its investments, something an outsider won't necessarily be able to verify. The monitors will also require monitoring. Banks may sacrifice diligent monitoring for other priorities, for example branch expansion and competition for market shares, as was the case in the build up to the Norwegian banking crisis. In that case, a firm's ability to maintain a credit line to its bank may not send a truthful signal to the financial markets about the quality of the firm's investments. Hiding irresponsible behavior from a lender would typically be easier during an economic boom, when fewer investments lose money even if the risks taken are generally too high. A firm concerned with satisfying shareholders might take on too high risks during a period of economic growth in order to get high earnings short-term, postponing the losses until the macro situation deteriorates.

When interpreting certification as securitization or the issuance of OMF. There are two important differences between the two however. By using a pool of mortgages as collateral for rated financial securities, the bank sends a signal to investors about the quality of the underlying assets, making it possible for them to hold a stake in the asset pool normally reserved for intermediary investment within the model framework.

For OMF the risks remain on the bank's balance sheets, meaning that banks still account for asset risk in a responsible fashion. Issuing OMF has no direct effect on the importance of the success probabilities  $p_H$  and  $p_L$ , so that the banks don't get the incentive to increase asset risks. For products like CDO's there is a risk of moral hazard. This process would likely reduce the effect of  $p_H$  and  $p_L$  on the issuing bank's investment decision. When the bank sells the claim to its assets to an SPV, it no longer holds an actual stake in the asset pool. There is no risk sharing and the value from originator certification may therefore be lost. This is especially true if the securities were valued at their time of origination, but their values are expected to have changed significantly since then.

Another implication of the model by Holmström and Tirole (1997) is that an extra dollar of informed capital is assumed to allow firms to increase their leverage. Securitization allowing increased leverage in banks therefore causes increased leverage in its borrowing firms as well. The whole economy faces the risk of becoming overextended and credit will be abundant during booms and even scarcer than necessary during recessions, causing additional volatility in the business-cycle. The authors refer to this trend as a possible looser banking norm in recessions. The Norwegian banking system was responsible in this respect, avoiding the type of securitization seen in US markets.

### 7.3 Managers' incentives

Although there is no management included in the model by Holmström and Tirole (1997), the banks are modeled so that they invest a share of their own capital into assets as opposed to just channeling outside uninformed investment. Banks are therefore stakeholders in their assets, which can provide them (at least partially) with the proper incentives to avoid excessive risk taking. In reality, bank managers have to answer to shareholders and investors interested in maximizing return and whose preferences may therefore not always be in the best interest of their bank in terms of long-term solvency. Within the model framework, we could imagine a high  $\gamma$  during economic booms, placing pressure on banks to increase the returns on their assets. Several incentive models simplify this problem by assuming that the manager is also a shareholder. The motivation for a manager to keep his job and the included benefits for an extended period of time, as well as maintaining a reputation for being responsible, may counter the priorities as a shareholder.

This conflict of interest moves the discussion into the theoretical territory of corporate governance. Byrd et al. (1998) note that stockholders only have limited influence over the company in which they own shares, despite the fact that they have capital at risk. They

perceive corporations as investment vehicles and want managers to maximize their equity for them, by working diligently and efficiently. The key assumption is that stockholders delegate day-to-day control of the company to managers, and so they cannot observe managerial decision making themselves. In a discussion of bank risk taking as a function of ownership structure Saunders et al. (1990) argue that a bank controlled by limited liability stockholders will take higher risks by increasing leverage. The ability to do so requires cooperation from management and a deregulated financial environment. In the name of equity maximization, diligence and efficiency may well be mutually exclusive virtues. Managers' and shareholders incentives caused a, possibly, too easy access to credit, as well as increased leverage both for banks and for borrowers in the booms preceding the Norwegian banking crisis and the financial crisis, as diligent monitoring and responsible investments gave way to competition for market shares and demand for a high return on investment. Since the industry average return on investment works as a benchmark for performance, there was an upward pressure on managers to finance risky projects with a high return in the build up to both crises. As long as the economy was doing well, the expectation of continued future growth had the immediate result of a high return on investment. The high risk of these loans defaulting was postponed until the economy slowed down. Thus, the strategy which yielded a high return during the economic boom also deepened the recession as the risky loans went bad and interbank- as well as bank credit to private enterprise dried up.

A major part of, otherwise uninvolved, external shareholders will have the opportunity to rid themselves of their stocks quite quickly in case their price is expected to decrease. This is particularly the case if the bank's stock is frequently traded on the open stock market and there are many relatively small shareholders at any given time. Given the opportunity to terminate their position without having to endure large losses, a significant part of shareholders would benefit from hiring the bank manager most capable of boosting short-term earnings, possibly at the expense of long-term stability. If the manager is involved in the same incentive scheme either through the ownership of stock options or being subject to performance related payoff, his preferences for risk and return will align with those of the external stockholders. Although, this is not a desirable strategy from the point of view of bank depositors and customers, interested in a secure long-term relationship with the bank, the ownership structure may hence induce risk seeking behavior from managers, if shareholders with limited liability and an appetite for risk represent an important influence, through providing a significant part of the banks funding. It is important to recognize that a failure to meet shareholders' demand for a

high return, may not only pressure for replacement of management, but also reduce the banks funding through reduced stock prices, as the sale volume increases.

Bank managers are of course well aware of the different trade-offs they face, when deciding on an investment strategy and the level of market exposition. Where the sudden deregulation of Norwegian financial markets in the 1980s may have caused banks to make uninformed decisions due to inexperience, this is hardly the case after over two decades of competition. Still, there seems to be obvious signs of history repeating itself without proper regulation. This is not because bank managers fail to learn from their mistakes, but because they are exposed to a destabilizing incentive structure promoting risk seeking behavior.

Another issue that can fuel risk seeking incentives is that some banking institutions are considered “too big to fail” by the government. A large bank is likely to be highly interconnected, so that its failure will have dire ramifications for the industry as a whole. This is a type of economic externality. Due to the high social cost of failure the probability of a bailout increases. Such a safety net forms a basis for moral hazard (Brunnermeier et al. 2009). The bank can gamble for resurrection by increasing its asset risks, boosting profits during a boom, while exposing the taxpayers to potential future losses. The government cannot credibly commit to allowing a “too big to fail” bank to go out of business if the externalities associated with the bankruptcy are large enough.

Despite this theoretical insight, the Norwegian banking system proved to be more robust during the recent financial crisis, than in the Norwegian banking crisis. The banks were exposed to relatively less asset risk and overextension was a smaller problem. Interventions by the central bank and the government were largely concerned with improving liquidity. Defaults are not necessary to generate contagion. A drop in asset prices can be enough. Funding liquidity describes how easily a bank can obtain financing in the credit market and this will naturally drop as asset prices fall, since investors perceive the banks to become more risky (Brunnermeier et al. 2009). Funding illiquidity is however not a result of insolvency or moral hazard and the government rightfully intervened to alleviate the credit crunch.

## 8 Conclusion

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The model by Holmström and Tirole (1997) explains in an intuitive way the need for indirect finance to supplement direct investment in a credit market with asymmetric information and moral hazard. A reduction in bank credit during crisis affects the composition of firms in the market by squeezing out small, opaque and poorly capitalized firms. The model however doesn't explore the importance of intermediary capitalization, although it does assume intermediaries to be capital constrained. Poorly capitalized financial intermediaries are more likely to experience solvency problems during a recession with falling asset prices. Falling asset prices cause liquidity problems that in turn can force a fire sale. A fire sale can lower asset prices even further causing a downward spiral (Brunnermeier et al, 2009). For banks with only a small capital buffer, falling asset prices can result in solvency problems and if poor capitalization is prevalent throughout the banking industry, then the whole system can quickly become adversely affected once under stress.

A bank failure can have more unfortunate consequences for the economy than those originating from the failure of other institutions of similar size going out of business. This is due to large externalities related to a bank failure. The clients of a failed bank, including other banks are temporarily cut off from an important credit source and solvency problems can thus spread. Since banks are connected to each other through credit-line arrangements in the interbank market, a major bank failure increases the chances of a systemic crisis. Brunnermeier et al. (2009) write that the opposite is true when for example a production company goes bankrupt. In that case, its remaining competitors will be better off, because of a larger demand for their products. The fact that banks are vulnerable to falling asset prices and the potentially large externalities associated with a bank failure clearly speak in favor of financial regulation that can render the system more robust to fluctuations in the business cycle.

Banks can profit on investing in smaller, more opaque projects than uninformed investors are comfortable with, and so it seems that the feature that created a need for financial intermediaries in the credit market in the first place, makes them more exposed to systematic risk during a recession. Prior to both crises, the lending standards of banks slipped as the desire to boost revenues came at the expense of diligent monitoring and screening, although in the case of Norwegian banks, these problems proved much more severe during the crisis of 1988-1993 than during the recent financial crisis.

Banks have the technology to monitor investments, which grants them access to a share of the lending market that normal investors find too risky. This however, does not guarantee

that a sufficient effort will be put into monitoring at all times. A good example would be the channeling of credit to the, in retrospect, clearly unsound subprime mortgage market by American banks prior to the financial crisis. Monitoring costs money and resources and investing heavily in it may thus seem like a wasteful practice to a profit maximizing manager during an economic boom when default rates are low. With this in mind, there might be a need for a stricter and less flexible industry standard to ensure a more precise and consistent mapping of true asset risks. Like I mentioned earlier, Basel III is taking a step in the right direction in this respect, by imposing banks to treat asset risks as if the economy were growing at an average pace during booms. This would prevent the riding of bubbles that was seen prior to both crises. Although Norwegian banks exerted more prudence than their US counterparts by refraining both from investing in subprime products and from using securitization to remove asset risk prior to the financial crisis, they still increased their lending significantly to profit on a flourishing domestic property market. The regulatory development suggests that there may exist an equilibrium level of capital requirements which will lead banks to choose a low-risk and stable investment strategy. In addition to enforcing a certain level of equity capital, there also needs to be restrictions on what can be counted as such in terms of quality, as well as an efficient system for risk weighing assets to provide the right incentives to the banking industry.

Brunnermeier et al. (2009) point to important differences between individual risk and systemic risk. Even if individual financial institutions face low risk, the system as a whole may become increasingly exposed to risk, which was the case prior to the financial crisis. By lending to each other strategically, banks can reduce their individual risk, but the risk is not necessarily removed from the system itself and since banks and other financial institutions lend to each other on a major scale, the industry becomes very interconnected and exposed to contagion in a recession when risks become more systematic (i.e. real estate prices).

Despite the benefits of a prudent lending strategy in the banking industry, future regulation still needs to allow banks to invest efficiently, to ensure that credit also reaches those opaque, yet profitable investment opportunities that individual investors fail to provide with funding in a credit market with asymmetric information. An alternative to the use of credit rationing as a means of achieving robustness may stem from the banks' ability to efficiently monitor investments and gather valuable information about their borrowers. If banks put a larger effort into screening and monitoring, then some of the riskier investments could be avoided. To ensure that diligent monitoring becomes common practice, bank operations need to be transparent, enabling investors, regulators and rating agencies to effectively assess intermediary investment activities.

The model by Holmström and Tirole (1997) shows how poorly capitalized firms that borrow, require monitoring. Otherwise, limited liability can cause them to act irresponsibly. It fails however to apply the same line of reasoning to financial intermediaries with little equity capital. When a bank gears up its balance sheet using securitization or becomes overextended in some other way, to the degree that it might be the source of serious liquidity problems later, outside investors should be able to discipline their bank by providing less capital. The ability to administer such punishment efficiently requires detailed information about the bank's financial situation and asset portfolio and so on. Such information is best gathered by an independent and unbiased regulatory agency, which should monitor the bank's activities more intensively than what has been done in the past and then make the acquired information readily available to investors. It is possible that a credible threat of market discipline could counter the destabilizing incentives that deepened liquidity problems in the banking industry during both crises. Vale (2004) notes that inadequate supervision and regulation of the banking system, in particular when the economy is growing at an above average rate, can lead to a pro-cyclical lending pattern and excessive risk-taking by banks. By increasing the transparency of bank operations and level of market discipline, the banking industry will hopefully move into a self-enforcing, good equilibrium where no bank will find excessive risk taking and lax monitoring routines profitable. A lack of market intervention can cause serious problems for over-leveraged banks when, or if, the boom turns into a bust. Booms allow bubbles to build up and all capital invested in them will be quickly eroded once they burst. To passively allow banks to gear up these investments through lax regulation only exacerbates the problem.

The Norwegian government stepped in to rescue important banks from failing during both recent crises, although solvency problems were only present during the Norwegian banking crisis. It is possible to imagine that the system could have been designed in such a way, so that no single bank was too large to fail. A tradition for government bailouts may initiate unfortunate rent seeking behavior by banks and further fuel the risk seeking behavior of banks with limited liability due to little equity capital. Mergers and acquisitions also often come into play when a bank is struggling against insolvency, causing banks to become even bigger in the wake of a crisis. This happened for example after the Norwegian banking crisis, when Nordea took over Kredittkassen.

The reward structure of the banking industry has made risk seeking behavior desirable to managers. It is better for a manager to emulate the profitable yet risky strategy of his competitors and eventually fail than to go against the stream and succeed in the long-run. Subprime lending by US banks and aggressive, uninformed competition for market shares in

new locations, as was the case prior to the Norwegian banking crisis are just two examples of unfortunate, yet at the time accepted, practices. I illustrated how the outside option for investors affects the riskiness of a bank's loan portfolio, and that outside pressure for a high rate of return can contribute to the adoption of a short-term profit maximization strategy by bank managers.

Banks need to collect outside financing from outside investors, less capable of monitoring, to lend efficiently. If these investors lending to banks demand a high rate of return, it can put pressure on a competitive banking industry to take more risks, as well as to move towards a higher share of short-term financing, being cheaper than long-term financing, but more likely to increase problems stemming from maturity-mismatch during recession.

Securitization has allowed banks to increase their leverage and at the same time, pass much of the asset risk itself on to a third party. While securitization improves asset liquidity, it also encourages a bank to increase the share of its portfolio dedicated to risky assets, to boost the return on investments. If these assets perform poorly ex-post, the banks' performance is more adversely affected, than it would be in an environment that discourages risky asset holding, according to Santomero and Trester (1998). This is exactly what happened to several large US banks during the financial crisis. Whether the prices of collateralized debt obligations held by American banks reflected their true market value has been the source of much speculation and mistrust in the US during the financial crisis. If a bank has private information about its assets, it might misuse its position when selling them to outsiders. Especially during favorable market conditions when the true risk of an asset is not instantly revealed. There are important distinctions between asset backed securities like CDO's and OMF. Mainly the fact that the issuance of OMF are subject to strict regulation, while the special purpose vehicles trading CDO's on behalf of banks existed in an unregulated loophole within the Basel regulation in place. Securitization made individual banks and other financial institutions seem safer, since they no longer were directly exposed to losses or defaults in their own asset portfolios. However, when accounting not only for risks faced by an individual bank, but also for the riskiness of the whole financial system, it becomes evident how securitization contributed to the problems of the recent financial crisis. The process of securitization does not remove the risks of the underlying assets, but rather distributes them around to those most willing to hold them. These buying institutions can be important investors and insurers in the financial market. Since the financial system is highly interconnected, falling asset prices will therefore still have a serious impact even if these assets are removed from the originator of the securities based on them. A weakly regulated form of securitization therefore seems



unadvisable in light of recent events. Even if using securitization as a means to remove asset risk from an individual institution is undesirable, the process still has the benefit of providing financial intermediaries with a new source of outside financing. This is also the case with regulated covered bonds like OMF. Issuing OMF seems a more responsible practice, since it does not remove risk. It still allows for leveraging by providing the banking industry with a relatively cheap financing option. This can be a good thing since issuing OMF can reduce the pressure on asset returns as well as reduce the dependence on short-term financing, hence alleviating the problems associated with maturity-mismatch during a recession. The Norwegian government's program for swapping OMF for government bonds during the financial crisis proved, that as long as the quality of OMF are regulated, injecting liquidity into the system in this way is both effective and does not hurt the taxpayers. A conceivable downside is that such an alternative financing option can make the leveraging of banks' balance sheets easier during booms, when the risks of the assets upon which the regulated OMF are based are low, potentially leading to overextension.

Knowing that the government is willing to rescue important banks in a liquidity crisis can create some unfortunate incentives with respect to risk taking during periods of prolonged economic growth. Banks know that the depositors and the regulator, representing the taxpayers, face most of the downside risk in the event of a failure, while shareholders as well as managers can enjoy a high although risky return as long as the economy is growing at a healthy pace. This relates to the bailout problem, where limited liability for the agent deciding on the desired level of risk causes irresponsible behavior. It is better for an investor to satisfy shareholders with a high return today and look good in comparison to his peers, with the possibility of incurring a large loss later, than to be prudent and deliver a relatively small but safe return. This is especially true if his bank is considered too large to fail by the government and will be rescued in the event of insolvency.

Norwegian banks have come a long way in terms of robustness, responsible investment and operating in a competitive market system since the Norwegian banking crisis. Liquidity problems during the recent crisis originated from international financial markets. Norwegian banks and regulators will possibly have to prepare to a larger extent for similar shocks coming from abroad in future. At present, there is a worry that stressed European governments like those of Greece, Spain, Portugal and Ireland may default on their debt. This is a worst case scenario which has not been incorporated into the stress testing of banks in the wake of the financial crisis, and that can possibly have an adverse effect on those European banks that have given loans to these governments.

## Appendix: A short introduction to banks, concepts and securities

To clarify some of the topics to be discussed in this thesis, I feel that it is necessary to provide a brief and factual insight into bank operations and financial securities. Where not mentioned otherwise, the source is Norges Bank. To begin with, table A1 is a generic example of a banks balance sheet.

Table A1

A simplified balance sheet for a bank	
Assets	Liabilities
Cash	Deposits
Securities	Short-term borrowing
Loans	Long-term debt
Other assets	Shareholders equity
Total assets (100%)	Total liabilities and equity (100%)

**Assets:** These are the bank's investments. Commercial banks typically hold a larger proportion of loans than securities and Norwegian banks are conservative in their choice of securities.

**Asymmetric information and adverse selection:** Asymmetric information simply means that one party to a business arrangement has superior, relevant information ex-ante. For example a loan applicant knows that he intends to quit his job after obtaining a mortgage, but avoids telling his bank. Adverse selection can, among other things, mean that a certain business contract attracts customers of an inferior quality. For example an increasingly expensive car insurance policy, is ceteris paribus likely to attract an increasing share of irresponsible drivers.

**Capital requirements:** These are bank regulations that attempt to control a bank's capital ratio, which is defined as the percentage of capital to risk-weighted assets. Capital requirements can be both quantitative and qualitative. The quality of capital is positively related to how easily it can be written down to compensate for reduced asset prices.

**Capital squeeze:** If there is a reduction in market demand, the profits of some firms become smaller or even turn negative. This development can in turn erode their own capital, increasing their share of debt financing. Hence, such a capital squeeze weakens their position in the credit market and might in the worst case deprive them of access to outside financing altogether, if banks and investors perceive these firms to have become too leveraged and risky.

**Credit crunch:** A credit crunch occurs when the amount of available credit in the market is reduced. If investors and credit institutions are faced with growing market risks, they are likely

to provide less credit to firms, consumers and investment projects. When the default risks of borrowing firms increase both investors and banks are forced to compensate by reining in on their lending and charging higher risk premiums through interest rates. Banks that are overextended can quickly become illiquid once the market situation deteriorates and asset prices fall. Their reduced liquidity makes them reluctant to issue new loans, and like other businesses, banks can experience difficulties gathering new financing in the market to keep up their lending activity. A recession is assumed to negatively affect both the availability of credit and the debt/equity ratio of firms' balance sheets, i.e. a simultaneous credit crunch and capital squeeze.

**Credit rating:** Financial institutions, securities and even countries are rated according to their perceived ability to repay a loan. Credit ratings are usually given by an independent rating agency like Moody's Investors Service or Standard & Poor's and their assessments send helpful signals to investors about the safety and quality of various investment opportunities. Banks and corporations as well as financial securities are rated on a scale from AAA to D. A security with a BBB- rating or lower is considered a junk bond, meaning that only those with a high appetite for risk should buy it. In Norway, banks are rated by DnB NOR Markets, which is an independent branch of Norway's largest bank.

**Debt ranking:** Senior debt surpasses junior debt in the queue for repayment when a company is liquidated. Subordinated debt would be an example of junior debt. The same system applies to claims against financial securities that are divided into senior/ junior tranches.

**Fire sale:** A fire sale refers to the premature liquidation of assets, usually at a low price. This is done to improve liquidity.

**Gearing and leveraging:** Gearing, or leveraging are terms for multiplying gains or losses. If an investment is financed by  $\frac{1}{2}$  cash equity and  $\frac{1}{2}$  outside debt, then the leverage is 2 to 1. To put it simply, this means that the investment is worth twice of what the investor originally could afford. This ratio is the accounting leverage. At the same time, the volatility of this investment is twice that of an unleveraged investment, i.e. an investment financed entirely by equity. Since the investor only actually owns half of his investment, his entire position will be lost should its value fall by 50 percent. Similarly, an investment with leverage of 4 to 1 will be lost after a 25 percent drop in value. The increase in volatility due to debt financing is the economic leverage. When referring to gearing or leveraging of the balance sheets of banks, I mean the amplification of assets and liabilities relative to equity. The intuition however, is the same as in the example described above. The gearing of balance sheets also increase market

exposure and volatility, making banking more profitable, but more risky as well. Some individual risks can be removed through diversification, but generally the argument holds.

**Haircut:** This determines how leveraged a bank can be. If a haircut is 2 percent, then a bank can borrow \$ 98 for \$ 100 worth of securities used as collateral. The bank will have to contribute the remaining \$ 2 from its equity. A recession will increase the haircut. In this example an increase to \$ 4, means that the bank must liquidate 50 percent of its assets or come up with new equity. The more leveraged a bank is, the more severe are the consequences of an increased haircut (Brunnermeier et al, 2009).

**Idiosyncratic and systematic risk:** Idiosyncratic risks can be diversified away in a well designed investment portfolio, by holding assets which prices are uncorrelated. The market price of copper does not affect the market price of cardboard. Systematic risks cannot be diversified away and are tied to the economic growth of the market that is being invested in, for example commercial property (Lintner, 1965).

**Inside lag and outside lag of regulation:** The inside lag refers to the time it takes for the government or a central bank to decide on a proper response, after it has become aware of an economic problem. An example would be the time it takes for a central bank, in a floating exchange rate regime, to change the interest rate after some news about the economy has become available. The inside lag of financial policy and legislation is typically longer than that of monetary policy, and is therefore relatively less efficient at counteracting sudden economic changes. The outside lag is the time span between the implementation of a response and when it takes full effect on the economy. The outside lag is typically longer for monetary policy, and Norges bank estimates that a change in its interest rate takes full effect after one to three years. However, if the market anticipates that the central bank is going to lower its interest rate to fight recession, there is an immediate, positive effect. And countercyclical monetary policy is thus made possible (Sørensen and Whitta-Jacobsen, 2005).

**Liabilities:** These constitute the bank's funding. When, for example, the value of the bank's assets (loans and securities) drop, there needs to be a similar reduction on the liabilities side, i.e. some of the liabilities have to be written down. Shareholder's equity is the easiest to write down to compensate for reduced asset value. Fundamentally, equity is the margin by which creditors will be covered if a bank's assets were liquidated. When this margin is diminished, the cost of a bank's borrowing increases, because investors grow skeptical.

**Liquidity problems:** Such problems arise because of the asset-liability maturity mismatch. As long as a bank's assets pay off as planned, liquidity is sound regardless of leverage. Funding problems occur when it is prohibitively expensive to sell off assets to reduce exposure and to obtain additional funding, referred to as low market liquidity and low funding liquidity respectively (Brunnermeier et al, 2009). Large deposit withdrawals or difficulties with renewing funding can force banks to sell assets prematurely.

**Liquidator:** A liquidator is the officer appointed when a company is liquidated. He is responsible for collecting all of the company's assets and for settling all claims against the company before it is broken up. In compulsory liquidation, the liquidator must assume control of all property to which the company appears to be entitled. The actions of the liquidator are supervised by a court of law.

**Maturity mismatch:** During the recent financial crisis, several banks experienced severe difficulties because they had a relatively large share of short-term debt. This was a much larger problem in the United States than in Norway. Short-term debt is a cheaper source of finance than long-term debt and is profitable when the market is in good shape, but it makes banks dependent on being able to refinance. Lending long and borrowing short is an important source of stress in the banking industry.

**Reserve requirements:** These are reserves that a bank must hold against deposits, which need to be very liquid. Cash kept in the central bank, or safe and liquid assets are good examples. When depositor demand for withdrawals increases, a bank can draw on its reserves and can thus avoid liquidating less liquid assets prematurely.

**Solvency:** If equity capital is exhausted, the value of a bank's liabilities become greater than the total value of its assets and it is then insolvent.

**Systemic banking crisis:** A systemic banking crisis occurs when the whole banking system is suffering from liquidity problems. Since the majority of a bank's assets are tied up in relatively long-term investments, banks are dependent on lending to each other in the interbank market at any given time to complete daily transactions. If a major bank in the system becomes illiquid, the problem might spread. This is also known as contagion and how easily the problems of one bank can affect other banks, depends among other things, on the structuring of credit lines in the banking system. Contagion can also refer to the spreading of financial problems in one country to others. For an analysis of systemic banking crisis and contagion, see Demirgüç-Kunt and Detragiache (1998).

In Norway there are only a small number of major banks, and Norges Bank is working on models for credit line arrangements that will make the banking system as robust as possible, against the prospect of illiquidity becoming contagious, in turn causing a systemic crisis. If a bank has more credit lines it will be able to withstand stress for a longer time, but if it should still fail, more banks will be affected in its wake. This is an important trade off for a financial regulator to consider. It should also be mentioned that the central bank can step in as a lender of last resort to rescue an individual bank from illiquidity, but preferably not insolvency. This is a problem however, since the distinction is often hard to make for an outside party. Besides, banks are usually reluctant to seek central bank aid since it sends a signal to the public that the bank is unable to attain credit in the interbank or stock market, and this signal may in turn trigger speculation about the banks solvency (Freixas and Rochet, 1997).

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